

# The Paryphantidae of New Zealand.

## No. V. Further New Species of *Paryphanta*, *Wainuia* and *Rhytida*.

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In the first issue of the Records of the Auckland Institute and Museum ((1930) the writer published a review of the New Zealand members of the *Paryphantidae*, which comprises five genera, *Rhytida*, *Paryphanta*, *Wainuia*, *Schisoglossa* and *Delos*. A number of new species and subspecies were described, and in three supplements (1932, 1936 and 1938) further new forms were proposed. The present supplement, Part 5, adds another fifteen new species and subspecies, bringing the total for the family to sixty-two.

In the original review it was stated, in reference to the genus *Paryphanta*, "that continuous land is necessary for dispersal and that the species must have developed approximately within or close to the areas they now occupy, and that topographic features, such as mountain ranges, river systems and islands, have played and are still playing an important part in the segregation and evolution of species."

Since the above was written certain areas, particularly the Levin district, have been subjected to fairly complete field survey, and the results are fully in accord with the statement made in 1930. In fact wherever subsequent work is done the tendency is to narrow the distribution of a species by the finding of self-contained subspecific forms within the range of that species. In all such cases an existing topographic barrier or evidence of some such past feature is almost invariably shown to operate, or to have operated, as the segregating influence. Thus the finding of a new species of *Paryphanta* typical from the Aupourian of the extreme north together with the fact that the *Rhytida* and *Placostylus* snails of this area are restricted also, is evidence that this northern extremity must have been long isolated by water from the rest of the North Auckland Peninsula. Under present conditions the country connecting the northern extremity with the rest of the North Auckland Peninsula is largely sand dunes, and is without the necessary forest cover.

A good example of imperfect segregation of subspecific forms is shown by *traversi traversi* and *traversi florida* n. subsp. It is assumed that these two subspecies developed respectively, north and south of the Ohau River, but owing to past changes in the course of that river a buffer zone of mixed colonies occurs.

No very satisfactory classification of races of land snails has been devised as yet. Specific and subspecific designation is in actual practice too rigid to achieve complete uniformity in values. It is the constant stumbling block of all taxonomic work—the application of a rigid nomenclature to animals which are not wholly rigid or stable in their make up.

Some opinions of Dr. H. A. Pilsbry, the greatest living authority on land mollusca, are worthy of note (1939, Land Mollusca of North America, Monograph 3, Acad. Nat. Sci. Phil. Vol. 1, Pt. 1, pp. XIV and XV):

"Subspecies are theoretically races showing some intergradation with neighbouring forms in a small proportion of the individuals, but characterized by having a definably different distribution, geographic or ecologic. This distribution may be contiguous to that of conspecific races, or it may be isolated by geologic, climatic or other conditions, as when races are confined to calcareous soils, to humid places in an arid region, or are insular. Most subspecies are recognizably differentiated populations which are not considered sufficiently distinct to be called species. They are merely incipient species, in which the discontinuity is incomplete, or is not strongly pronounced."

"The term '*forma*' has also been used for forms which show some differentiation, consistent in the colony, but either below the grade usually associated with subspecies, or restricted to single or a few colonies, thus having a much narrower range than is usually covered by a subspecies and without noticeable difference in the local conditions 'Forms' or 'little races' of this kind are numerous in *Oreohelix*. They seem to be equivalent to the 'microgeographic species' of Dobzhansky."

By the above criteria many of the *Paryphanta* colonies in artificially isolated remnants of the original forest cover both on the plain around Levin and in the low country of West Haven Inlet, Nelson, are beginning to exhibit individual characteristics and ultimately they may acquire sufficient distinction to be regarded as forms or even subspecies.

The writer's action in applying subspecific names to colonies which are separable from other colonies merely on account of different coloration is open to criticism. Justification for this action is the fact that these differences in coloration are characteristic for a definable area segregated by topographic boundaries. Thus these colour differences are not merely varying factors that may occur in any breeding colony.

The *Paryphanta* animal is a sensitive creature and cannot adjust itself to a wide range of conditions. More or less continual dampness is essential, and since their food consists mainly of earthworms, there are many parts of the forest unsuitable to worms and snails alike.

#### ACKNOWLEDGMENTS.

Several people have contributed very largely to this paper with detailed field work. They are Messrs. R. A. and H. S. Prouse of Levin, Mr. A. C. O'Connor of Wellington and Mr. W. H. Johnston of Seddonville. The Prouse cousins carried out a thorough survey of the Horowhenua District from Otaki to Tokomaru, as well as considerable work in West Nelson areas. Mr. O'Connor made available the results of his numerous field trips over the past five years, and generously donated to this Museum material for the selection of type specimens. Mr. Johnston made a careful search for new localities in the Seddonville area, which resulted in the finding of a new subspecies. Others have

helped with material and information. They are Dr. R. A. Falla, Director, Canterbury Museum, Mr. W. Harris and Miss L. B. Moore, Wellington, Mrs. M. Mouat, Auckland, Mr. A. Richardson, Papakura, Mr. A. Harvey, Collingwood, Mr. A. G. Stevenson, Auckland, Mr. A. H. Watt, Parengarenga, Mrs. I. Worthy, Patumahoe, and Mr. A. J. Evans of Onekaka.

The writer is especially indebted to the Prouse cousins, not only for field data and the fine material presented to the Auckland Museum as the direct result of their survey, but also for the efforts they are making to preserve restricted colonies from destruction. The fact that four colonies of these snails occur on their respective properties at Levin and in West Nelson is the best assurance we have that these restricted colonies will have every possible chance of survival.

### Genus **PARYPHANTA** Albers, 1850.

#### Subgenus **PARYPHANTA** Albers, 1850.

Type (Monotypy): *HELIX BUSBYI* Gray.

Typical *Paryphanta* is now restricted to the genotype and an allied new species which is described below. These two species differ from the subgenus *Powelliphanta* O'Connor, 1945, by having a substantial limy shell underlying a heavy and almost uniformly dark coloured coating of conchin. The last half-whorl shows considerable acceleration and the egg is thick-shelled, white and limy, without a cuticle. (See A. C. O'Connor, 1945, Trans. Roy. Soc. N.Z. 75, pp. 54-56.)

#### **Paryphanta busbyi** (Gray, 1840) Pl. 9, fig. 1. Text fig. A6.

The well-known North Auckland Kauri snail still exists in scattered forest reserves from the Kaipara district to the vicinity of Kaitaia. It occurs also without change on the outlying islands of the Poor Knights (Tawhati Rahi) and Taranga or Hen Island, but the occurrences from the extreme north of the North Auckland Peninsula are specifically distinct and have evidently diverged as the result of long isolation.

#### **Paryphanta watti** n. sp. Pl. 9, fig. 2. Text fig. A5.

Compared with *busbyi* this new species is smaller, more depressed, has a more shallow body-whorl, the addition of radial wrinkles between the spiral cords and a distinctive coloration. It is never greenish, but ranges in colour between tawny-olive and olive-citrine on the spire whorls to a warm black over most of the body-whorl. The spiral cords, nine or ten in number, fade out over the last half-whorl as in the genotype. Protoconch with indistinct arcuate radials; early spire-whorls with dense irregular malleations; body-whorl with closely spaced arcuate to chevron-shaped radials between the spiral cords.

The species does not grow so large as *busbyi*, even the 53.5 mm. example of *watti* has an adult lip, but *busbyi* of this size is definitely juvenile.

Major diameter:	Minimum diameter:	Height:	Depth of body-whorl*
78.5 m.m.	61.5 mm.	42.0 mm.	32.0 mm. ( <i>busbyi</i> , large example, near Dargaville)
62.5 mm.	47.5 mm.	33.5 mm.	26.5 mm. ( <i>busbyi</i> , Hokianga)
62.0 mm.	46.0 mm.	31.0 mm.	23.5 mm. ( <i>watti</i> , holotype)
56.0 mm.	42.0 mm.	27.5 mm.	24.0 mm. ( <i>watti</i> , paratype)
53.5 mm.	41.5 mm.	27.0 mm.	22.0 mm. ( <i>watti</i> , paratype)

Dimensions of an egg taken at Unuwahao, 14 mm. x 11 mm. It has a rough limy shell without a cuticle as in *busbyi*.

\*Measurement in this case is taken at the extreme left, directly opposite termination of last whorl. This is on account of the rapid increase in the whorl-height at the usual place in front of the body-whorl.

*Localities:* Unuwahao, 900 feet, near track between Spirits Bay and Tom Bowling Bay, under decaying leaves in coastal forest (type); Kahuronaki (Kahuroa on survey maps) between Te Paki and the Kapo Wairua Road (A.W.B.P., Feb., 1944); Cape Maria van Diemen mainland, consolidated dunes underlying the Recent dunes, with *Placostylus ambagiosus priscus* Powell, 1938; probably Pleistocene.

*Holotype:* Auckland Museum.

The finding of a distinct species of the *busbyi* group from the Cape Maria-North Cape block is of interest since *busbyi* typical shows no variation over the remainder of the North Auckland Peninsula. Nor does it vary from the outlying islands, the Poor Knights and the Hen and Chickens. Fossil examples from limestone cave deposits near Hikurangi are typical *busbyi*, so the far northern *watti* must have diverged through long isolation along with other distinctive elements of the Aupourian land fauna, that is, *Placostylus ambagiosus*, *priscus*, *consobrinus* and *annectens* as well as *Rhytida duplicata* and *duplicata vivens* n. subsp.

The species is named in recognition of assistance in the field, given during three visits to the extreme north, by my esteemed friend Mr. A. H. Watt of Paua, Parengarenga.

### Subgenus **POWELLIPHANTA** O'Connor, 1945.

Type (o.d.): *HELIX HOCHSTETTERI* Pfeiffer.

This subgenus contains all the remaining New Zealand members apart from the two species of the typical subgenus, *busbyi* and *watti*. The composition of the shell differs from that of the typical subgenus in being mostly conchin. They are variously radially striped or spirally banded, and the egg has a thin limy shell, always with a transparent cuticle.

Some species, notably *sheddeni* and *rossiana*, are so lacking in lime that they quickly collapse when vacated by the animal, but the shells can be softened and the shape restored by a technique (see O'Connor, 1945, p. 56) which involves relaxing the shells by placing them in very hot water. Only in exceptional instances does the shell long survive

death of the animal. Subfossil examples of *Powelliphanta* are known only from limestone caves (near Te Kuiti, and Punipaua, West Nelson), where replacement of the conchin by lime has occurred.

The subgenus may be divided into well marked series each of which has a definite area of distribution: They are:—

A, the *rossiana* series, which commences near East Dome, Southland, and terminates so far as is known with *gagei* from Rewanui, Greymouth, and Kirwan's Hill, north-east of Reefton. These are all of small size, very thin and composed almost entirely of conchin. They are dark greenish to dark brown with black axial streaks as the only colour pattern. The radula in *rossiana*, *gagei* and *fletcheri* is so similar in formula and in detail to that of the larger typical species that sub-generic separation is not warranted.‡

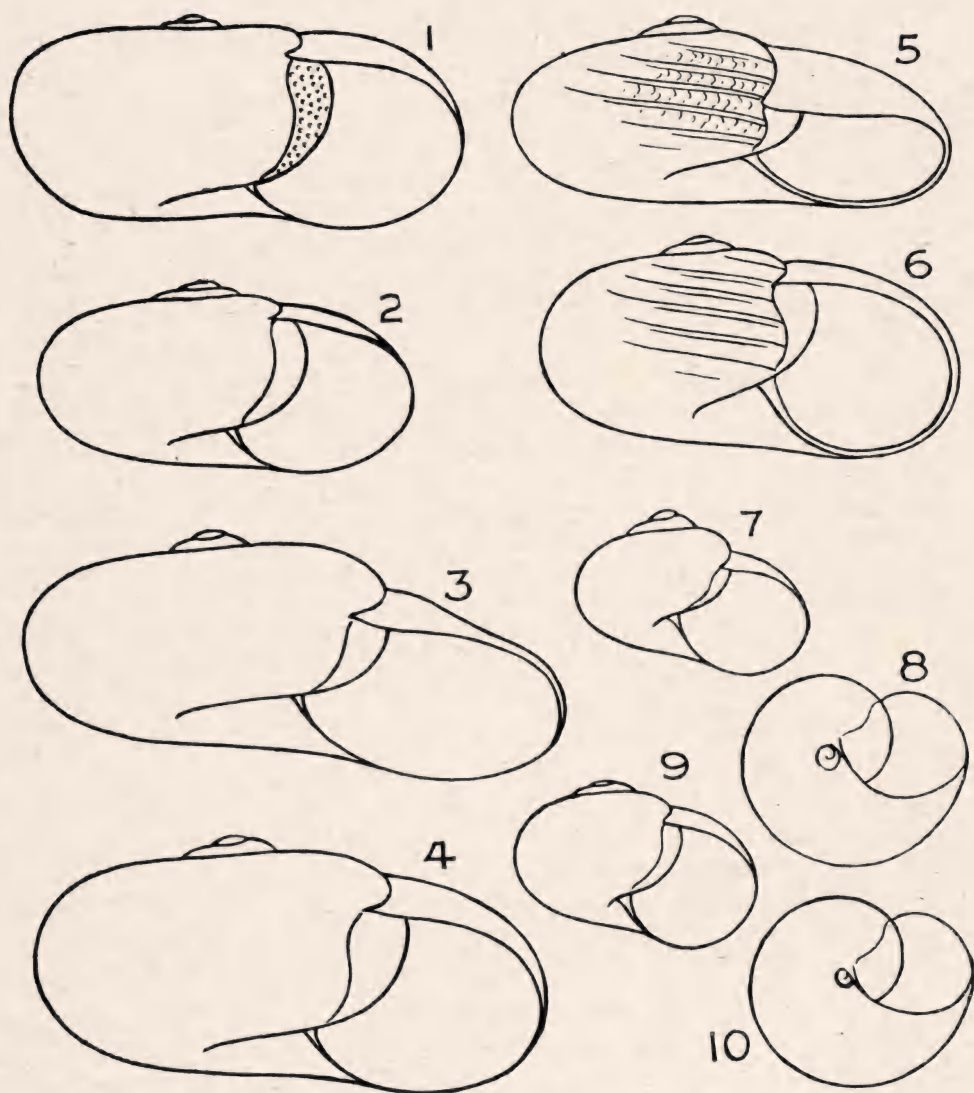
B, the *lignaria* series commence near Westport and extend northward to West Nelson and the western slopes of the Mount Arthur Tableland. The dominant feature of the *lignaria* series is radial colour banding, but it tends to plain ground colour both at the commencement with *unicolorata* and at its termination in the *superba* group, the largest members of the genus. Several members of the *lignaria* series show granulation of the parietal callus, a feature which comes in north of Karamea and is last seen in this group in two subspecies of *superba* from the Heaphy end of the Goulard Downs area. The *lignaria* series have the deep body-whorl and there seems little doubt that both the *hochstetteri* and the *gilliesi* series had their origin respectively from *lignaria* stock in West Nelson.

C, the *gilliesi* series are characteristic of the Wakamarama Range and the mountains of the eastern side of the Aorere Valley, West Nelson. They must have arisen by mutation from the *lignaria* stock. They are small and have a shallow body-whorl, but are the only group other than *lignaria* to possess the granulated callus. Also the Goulard Downs *jamesoni*, although having a smooth callus and spiral lines on the dorsal surface still preserves the *lignaria* radial streaks on the base.

D, the *hochstetteri* series are large, spirally banded and zoned, and with the deep body-whorl, as in *superba*. They occur on the Tasman-Pikikiruna Ranges of Nelson, the mountains of Marlborough and on the Ruahine Range of the North Island. The link with *superba* of the *lignaria* series is gauged from the fact that *superba* shows vestigial radials in its juvenile stage and an occasional incipient spiral in its adult stage.

E, the *traversi* series belongs to the coastal plain north of Wellington and west of the Tararua Range. It is suggested elsewhere in this paper that the *traversi* series arose by mutation from *obscura-bicolor* stock of the *hochstetteri* series. The *traversi* series are of smaller size and have the shallow body-whorl, but does not possess the granulated callus of the *gilliesi* series.

‡Dental formulae:—*P. busbyi*, 50 + 0 + 50; *hochstetteri*, 67 + 1 + 67; *h. bicolor*, 67 + 1 + 67; *superba*, 66 + 1 + 66; *lignaria*, 70 + 1 + 70; *unicolorata*, 54 + 1 + 54; *gilliesi*, 59 + 1 + 59; *g. subfusca*, 64 + 1 + 64; *traversi*, 65 + 1 + 65; *rossiana*, 69 + 1 + 69; *gagei*, 59 + 0 + 59; *fletcheri*, 66 + 1 + 66.



Text Fig. A.

1. *Paryphanta* (*Powelliphanta*) *superba harveyi* Powell, n. subsp.
2. *Paryphanta* (*Powelliphanta*) *superba mouatae* Powell, 1936.
3. *Paryphanta* (*Powelliphanta*) *superba richardsoni* Powell, n. subsp.
4. *Paryphanta* (*Powelliphanta*) *superba superba* Powell, 1930.
5. *Paryphanta* (*Paryphanta*) *watti* Powell, n. sp.
6. *Paryphanta* (*Paryphanta*) *busbyi* (Gray, 1940).
- 7-8. *Paryphanta* (*Powelliphanta*) *spedeni lateumbilicata* Powell, n. subsp.
- 9-10. *Paryphanta* (*Powelliphanta*) *spedeni* Powell, 1932.

(All figures to uniform scale of 4/5)

## A. THE ROSSIANA SERIES.

**Paryphanta spedeni** Powell, 1932. Text figs. A9-10.

1932 *Paryphanta spedeni* Powell, Rec. Auck. Inst. Mus. Vol. 1, No. 3, p. 159, Pl. 28, figs. 3, 4, and 5.

*Locality*: West side of Mataura River, opposite East Dome, on range at about 3,200 feet, Southland (corrected type locality, see Powell, 1938, Rec. Auck. Inst. Mus., Vol. 2, No. 3, p. 137).

**Paryphanta spedeni lateumbilicata** n. subsp. Text figs. A7-8.

In my 1938 paper (l.c.) I extended the range of *spedeni* by recording a new locality, Billow Mountains, near Lake Monowai, but now, after again examining the small series of five specimens, three of which are in the collection of Mr. A. C. O'Connor, I am convinced that a new subspecies is represented by the Monowai occurrences. The Monowai shells have a less globular body-whorl, more exserted spire, wider umbilicus, weaker spiral striae and are darker, especially on the base, while the dorsal surface lacks the characteristic bronze sheen of *spedeni* typical. The dorsal colour in both *spedeni* and *lateumbilicata* is very dark greenish brown, but the former has a diffused argus-brown tinge and in the latter the tone is nearer to raw-umber. The ventral surface is between olive-brown and dark-olive in *spedeni* typical, with irregular axial streaks of very dark green, almost black. In *lateumbilicata* the base is so much darker that the axial streaks are scarcely apparent.

The following table indicates the relative size of the umbilicus in species and subspecies.

<i>spedeni spedeni</i> .		<i>spedeni lateumbilicata</i> .	
Major diameter.	Width of umilicus.	Major diameter.	Width of umbilicus.
31 mm.	3.00 mm.	30.5 mm.	3.75 mm.
36 mm.	3.50 mm.	32.5 mm.	4.00 mm.
39 m.m.	3.75 mm.		

Table of dimensions for *spedeni* and s. *lateumbilicata*.

Major diameter :	Minimum diameter :	Height :	Depth of body-whorl :
<i>spedeni spedeni</i>			
39.0 m.m.	30.0 mm.	25.0 mm.	16.0 mm.
35.8 mm.	28.4 mm.	23.5 mm.	14.0 mm.
33.0 mm.	26.25 mm.	23.0 mm.	13.5 mm.
28.0 mm.	23.00 mm.	20.5 mm.	13.0 mm.
<i>spedeni lateumbilicata</i>			
35.8 mm.	28.0 mm.	24.0 mm.	13.2 mm.
33.0 mm.	26.5 mm.	22.5 mm.	12.75 mm.
32.0 mm.	26.0 mm.	21.5 mm.	12.5 mm. (holotype)
29.5 mm.	24.5 mm.	20.5 mm.	12.2 mm.

*Localities*: Billow Mountains at 3,000 feet near South West shore of Lake Monowai, Otago (type collected by Mr. S. W. Mayo, December, 1937); Mount Hindley at 3,500 feet (collected by Mr. A. Clark, 1938) per Mr. A. C. O'Connor.

*Holotype*: Powell collection, Auckland Museum.

## B. THE LIGNARIA SERIES.

In the collection of Mr. Arthur Richardson of Papakura there is a "*lignaria*" from Larrakin's Creek, a tributary of the South Branch of the Mokihinui River, draining the high watershed between the Mokihinui and Matiri Rivers (collected by E. De Malmanche, 1938).

If this specimen came from the upper reaches of the creek it would be approximately topotypic of Hutton's original *lignaria* which was from a "saddle between Mokihinui and Lyell Rivers."

Unfortunately Hutton's type is not in the Canterbury Museum as stated by Suter (1913, Man. N.Z. Moll., p. 783), but was returned by Hutton to its discoverer, Dr. Gaze, Westport (Suter l.c. Errata p. XIV). The original description reads—"irregularly banded in the direction of the growth lines with dark reddish-brown and pale brownish-yellow-upper surface finely irregularly granulated by deeply undulating impressed lines—." In 1900 Hutton figured an example without colour bands from Mt. Rochfort near Westport and erroneously ascribed it to his original *lignaria* of 1888. This is the uniformly light coloured form which I described in 1930 as *P. unicolorata*, type from the flat at Seddonville.

Just across the Mokihinui River from Seddonville and extending northwards to Karamea there occurs the alternately light and dark axially banded form which I ascribed to Hutton's original *lignaria* (Powell 1930, Rec. Auck. Inst. Mus. Vol. 1, No. 1, p. 42, Pl. 4, f.1.). Later, (Powell 1941, l.c. Vol. 2, No. 5, p. 239) I nominated at St Helens, Mokihinui specimen as neotype, since the original holotype is presumed lost. It is possible that an unlabelled specimen from the collection of the late Mr. Boswell of Westport, and now in the Auckland Museum, is Hutton's missing holotype. It has the base missing as mentioned by Hutton, but the dimensions are slightly greater. If this is the type then my 1930 interpretation of *lignaria* is correct.

On the other hand the sparsely striped *lignaria oconnori* Powell 1938 (Rec. Auck. Inst. Mus. Vol. 2, No. 3, p. 134), which comes from the headwaters of the Leslie River, 2,000 feet, western slopes of the Mount Arthur Tableland, is very close to, but not identical in coloration with, the Larrakin's Creek shell, which by its location should be nearer to the original *lignaria* than my St. Helens neotype.

The position cannot be finalised until topotypes of Hutton's species are obtained, but the indications are that *oconnori* will stand as a northern subspecific form and that the Mokihinui-Karamea coastal form will require to be named, my nomination of a St. Helens specimen as neotype becoming void.

### Key to *Unicolorata* Subspecies.

- Dorsal surface plain or with narrow light brown spiral lines.
- Ventral surface plain ..... *unicolorata unicolorata* Powell
- Dorsal surface with dense dark reddish-brown spiral lines.
- Ventral surface with dense light-brown narrow spiral lines.
- ..... *unicolorata rotella* Powell
- Ventral surface with spiral bands and lines of deep reddish-brown .....
- ..... *unicolorata johnstoni* n. subsp.



**Paryphanta unicolorata Powell, 1930.**

1930—*Paryphanta unicolorata* Powell, Rec. Auck. Inst. Mus. Vol. 1, No. 1, p. 43, Pl. 4, f. 2 and Pl. 6, f. 6.

Typical *unicolorata* has an almost uniform ground colour of between ecru-olive and Isabella colour (Ridgway). A large series from the Seddonville flat (around the type locality), collected by Mr. A. C. O'Connor, shows the species to be constant except for occasional variants with fine dense light-brown spiral lines on the dorsal surface and about 5% with irregularly disposed narrow dark-brown axial streaks, as in *rotella*. Typical *unicolorata* occupies the Seddonville flat and extends to the east of Chasm Creek, which feature Mr. W. H. Johnston has found to form the boundary between *unicolorata* and a new subspecies which occupies the area to the west of Chasm Creek.

The distributional area of *unicolorata* is limited to the north by the Mokihinui River and to the west and south by the encircling sweep of Chasm Creek. The eastern extension of the species remains to be determined.

*Localities*: Seddonville, West Coast, Nelson, from around flax bushes (*Phormium*) (C. L. Wragge, 1908) (type); Seddonville flat, under logs and clumps of blackberry on partially cleared land (A. C. O'Connor, 5:11:1940); East, or Seddonville side of Chasm Creek, near confluence of Chasm Creek and Mokihinui River (W. H. Johnston, 1945).

**Paryphanta unicolorata rotella Powell, 1938.**

1938—*Paryphanta unicolorata rotella* Powell, Rec. Auck. Inst. Mus. Vol. 2, No. 3, p. 137, Pl. 33, figs. 8 and 9.

The presence of radial streaks in typical *unicolorata* as well as in *rotella* does not reduce true *rotella* to a synonym since that subspecies was based primarily upon the dense pattern of dark red-brown spirals on the dorsal surface and subobsolete light-brown spirals on the base. The distribution of *rotella* is high country along the radial spurs running westward from Mt. Glasgow. The type locality is 1,200 feet, between the headwaters of the St. Andrews and St. George's Streams and it is recorded again from the same area at 1,800-2,000 feet. A third occurrence is on the ridge, 400-500 feet near the old State Mine. Thus the high country *rotella* form invades the higher country of the area of *unicolorata*-typical by coming down a leading spur from Mt. Glasgow and entering at the eastern end of the *unicolorata*-typical area, where no barrier exists.

*Localities*: Between headwaters of St. Andrew's and St. George's Streams, tributaries of the Ngakawau River, at 1,200 feet, Western slopes of Mt. Glasgow, West Nelson (type); vicinity of headwaters of St. Andrew's Stream at 1,800-2,000 feet; ridge between Coal Creek and Chasm Creek at 700 feet; East side of Chasm Creek, 400-500 feet near old State Mine (W. H. Johnston).

**Paryphanta unicolorata johnstoni n. subsp. Pl. 9, figs. 3 and 4.**

Dorsal surface prominently spirally banded and lined in dark reddish-brown, upon a diffused, mostly light reddish-brown ground colour. There is a subsutural band of yellowish-olive and the ground colour of

the early whorls is more olive than reddish. There are five spiral colour lines on the early whorls and from ten to twelve lines and bands on the dorsal surface of the body-whorl. The ventral surface is conspicuously spirally banded and lined with chestnut on a yellowish olive or Isabella-coloured (Ridgway) ground. The inner third of the base is free from colour lines. The basal colour and pattern resembles that of *hochstetteri*. There are from 15 to 17 spiral colour bands and lines on the base. These bands are distant and irregularly spaced with groups of two to five closely-spaced lines between them.

Major diameter 45.5 mm.; minimum diameter 37 mm.; height 25 mm. (holotype)  
Major diameter 40.0 mm.; minimum diameter 34 mm.; height 23.8 mm.

*Locality:* West side of Chasm Creek towards junction with the Mokihinui River at 100-500 feet (W. H. Johnston, 1945).

*Holotype:* Auckland Museum.

This subspecies is likely to occur along the coastal range to about six miles south of the type locality. It is a rectangular area bounded by the Mokihinui River to the north, the sea to the west, the Ngakawau River to the south, and Charming Creek and Chasm Creek to the east. Charming Creek flows south to the Ngakawau and Chasm Creek bears northward to the Mokihinui. Chasm Creek affords a clear-cut separation between *johnstoni* and the other two forms of *unicolorata*, typical and *rotella*. Similarly the Mokihinui River is the barrier between the *unicolorata* series and "*lignaria*," the latter commencing almost immediately, on the north side of the river.

The status of the shells from Mt. Rochfort near Westport, which were wrongly ascribed by Hutton (1900, Trans. N.Z. Inst. 32, p. 22, Pl. 2) to his *lignaria* of 1888, still remain to be satisfactorily placed. They may be either *rotella* or still another subspecies.

#### Key to *Superba* Subspecies.

- Body-whorl deep, compared with maximum diameter.  
Shell very large (up to 90 mm.)  
Colour uniformly yellowish to old-gold.  
Parietal callus smooth ..... *superba superba* Powell.  
Parietal callus granular ..... *superba proussorum* n. subsp.
- Shell smaller (up to 63 mm.)  
Colour cinnamon-brown.  
Parietal callus smooth ..... *superba mouatae* Powell  
Colour light brown axially banded with reddish brown.  
Parietal callus granular ..... *superba harveyi* n. subsp.
- Body-whorl shallow, compared with maximum diameter.  
Shell of medium size (up to 76 mm.)  
Colour orange-citrine (darker than *superba typical*)  
Parietal callus smooth ..... *superba richardsoni* n. subsp.

#### *Paryphanta superba* Powell, 1930. Text fig. A4.

1930. *Paryphanta superba* Powell, Rec. Auck. Inst. Mus. Vol. 1, No. 1, p. 41. Pl. 4, f. 3 (not Pl. 3).

The type locality for this species is Cedar Creek Ridge at about 2,500 feet, between the Boulder and Clark Rivers on the eastern side of the Aorere Valley, West Nelson.

At the time of description of the species I included in its range two specimens from five miles south of Rocks Point and North of Karamea Bight. These were figured (Powell 1930, Pl. 3) from an excellent photograph by Mr. Wm. C. Davies of the Cawthron Institute, Nelson, but I did not handle the actual specimens, which now prove to be subspecifically separable. Recently I examined about a hundred examples collected by Messrs. H. S. and R. A. Prouse from between Rocks Point and Kahurangi Point. These show a constant difference from typical *superba* in the form of the parietal callus, which is granulate, that of *superba* typical being constantly smooth. All the records of *superba* were then checked and it was found that the Wakamarama Range shells were true *superba*, although on the opposite side of the Aorere Valley to the type locality. The Goulard Downs provides high country continuity between the Eastern Aorere Mountain systems and the Wakamarama Range, but so far no colonies of true *superba* have been located in the Goulard Downs area, but in place of it there are at least three subspecific forms, each apparently occupying its own restricted area. One of these is the form which I described as *Paryphanta mouatae* (Powell, 1936, p. 31) from between 15 Mile Creek and Saxon Creek. The other subspecific forms are dealt with, following. If typical *superba* formerly ranged across the Goulard Downs area it may yet remain isolated on high areas such as Downs, 3,650 feet, Hawke's Knob, 2,755 feet, and Mt. Perry, 3,993 feet.

*Localities* (*superba* typical): Cedar Creek Ridge, 2,500 ft. eastern side of Aorere Valley (type); Bock Peak, 3,200 ft. near Mt. Stevens, Wakamarama Range, west of Bainham; and Knuckle Hill, 1,661 ft., between the head waters of the Kaituna River and West Haven Inlet.

### ***Paryphanta superba prouseorum*, n. subsp.**

1930. *Paryphanta superba* Powell, Rec. Auck. Inst. Mus. Vol. 1, No. 1 (in part) Pl. 3 only.

Shell very large, the maximum so far known for the genus. It is identical in shape and ground colour (sulphine-yellow to old-gold of Ridgway) with *superba* typical, but differs constantly in having the parietal callus finely granulated instead of being smooth. There is a tendency also, especially in young shells, to develop irregular axial diffused bands of reddish-brown and on the base an occasional spiral of pale olive-brown. The parietal callus in young shells is purplish-grey and becomes chocolate only when fully adult. In *superba* typical the callus is dark chocolate at all stages of growth. The granulations are particularly noticeable in young examples of the subspecies, but are entirely absent at all growth stages from the typical species.

The dimensions are given in a comparative table following the descriptions of all of the *superba* subspecies.

*Localities*: Between Kahurangi Point and Rocks Point, 2 to 3 miles inland at 1,500-2,000 feet, collected by Messrs. H. S. and R. A. Prouse (type); 5 miles south of Rocks Point, north of Karamea Bight and 1 mile inland at 1,000 feet, collected by Mr. Wastney of Nelson.

The subspecies is named in recognition of the excellent field work of both Messrs H. S. and R. A. Prouse.

**Paryphanta superba richardsoni** n. subsp. Text fig. A3.

This is a depressed *superba* of darker colour and with a smooth parietal callus. The ground colour is orange-citrine (Ridgway) with diffused very pale reddish-brown axial streaks, and the rest stages marked by narrow olive-coloured axial lines; parietal callus chocolate. The depressed shape is caused by the much reduced depth of the body-whorl compared with typical *superba*, *superba prouseorum*, *superba mouatae* and *superba harveyi*. The measurement for body-whorl depth is taken vertically in front of the shell and extends from the suture to the greatest basal convexity before incurving to the umbilicus. This is the final column of dimensions in the table following.

*Localities:* Perry's Pass, two miles from Blue Duck Creek Hut, Gouland Downs, West Nelson (type), collected by Mr. A. C. O'Connor 3:11:1939 and Mr. A. Richardson.

*Holotype:* Auckland Museum.

**Paryphanta superba mouatae** Powell, 1936. Text fig. A2.

1936. *Paryphanta mouatae* Powell, Rec. Auck. Inst. Mus. Vol. 2, No. 1, p. 31, Pl. 8, figs. 7 and 8.

After seeing extensive series of this subspecies collected by Mr. A. C. O'Connor, it became evident that two subspecies were covered in my original description, a small almost uniformly dark form with a convex top and a smooth parietal callus, which is typical *mouatae*, and an alternately yellowish-brown and reddish-brown axially banded form, with a flat top and a granulated parietal callus, which is described, following, as *superba harveyi* n. subsp.

Shell of *mouatae* much smaller than *superba* typical and much darker. The top is low, slightly convex and scarcely sunken at the suture. The outline of the body-whorl is evenly arcuate from the suture to the umbilicus. The ground colour is cinnamon-brown fading to dresden-brown around the umbilicus and is irregularly axially streaked with mars-brown and an occasional growth mark of olive-brown (Ridgway). The parietal callus approximates to mars-brown and is quite smooth.

*Localities:* Gouland Downs, West Nelson, between 15 Mile Creek and Saxon Creek (collected by Mr. A. Harvey and obtained per Mrs. M. Mouat (holotype); Headwaters of Saxon Creek, 3½ miles from Blue Duck Creek Hut (collected by Mr. A. C. O'Connor, 1:11:1939).

**Paryphanta superba harveyi** n. subsp. Pl. 9, figs. 5 and 6. Text fig. A1.

1936. *Paryphanta mouatae* Powell, Rec. Auck. Inst. Mus. Vol. 2, No. 1, p. 31 (in part, reference to parietal granulations).

This is the handsome axially banded form to which I originally intended the name *mouatae* to apply. Only dead shells of the banded form were available at the time of description, and by the selection of a small almost uniformly coloured example as holotype *mouatae* was fixed as described above, but now leaves the banded form with the granular callus available to bear the name of the original collector, Mr. A. Harvey, of Collingwood.

Shell differing from *superba mouatae* in being almost flat on top with the sutural area sunken and the crest of the body-whorl higher than the suture, forming in profile a high subangle to the outline of the body-whorl, when viewed from the front. There is a second subangle towards the umbilicus. The connecting curve between the two subangles is obliquely broadly arcuate. Ground colour buckthorn brown axially banded with broad zones of Hay's russet. Parietal callus Hay's brown (Ridgway) or possibly darker in fresh specimens, sparsely but distinctly granulated.

*Locality:* Gouland Downs—Heaphy Track, probably in Buller County near to the Buller Boundary. Collected by Mr. A. Harvey.

Unfortunately some of Mr. Harvey's numbered localities became detached from the specimens he gave Mrs. Mouat, but by elimination it is almost certain that the above locality applies to the shells here described. All the Harvey material came from the Gouland Downs—Heaphy track—and the presence of parietal granules in *harveyi* would suggest that the type locality was from the Heaphy end, especially since both *annectens* and *superba prouseorum* have the granular callus. This feature disappears in the north-eastward succession of subspecies, i.e., *superba mouatae*, *superba richardsoni* and *superba superba*; in that order.

*Holotype:* Auckland Museum. The writer is indebted to both Mr. A. C. O'Connor and Mrs. M. Mouat for the type material of this subspecies.

**Table of dimensions for *superba* and subspecies:**

Major diameter :	Minimum diameter :	Height :	Depth of body-whorl*	
<i>superba</i>				
80.0 mm.	67.0 mm.	40.0 mm.		
77.0 mm.	65.0 mm.	38.0 mm.		(holotype)
76.5 mm.	64.5 mm.	39.0 mm.	28.0 mm.	
70.0 mm.	59.5 mm.	39.5 mm.	24.75 mm.	
61.5 mm.	55.0 mm.	33.0 mm.	25.0 mm.	
56.0 mm.	47.0 mm.	32.0 mm.	23.5 mm.	
<i>superba prouseorum</i>				
90.0 mm.	74.0 mm.	38.0 mm.		(H.S.Prouse coll.)
89.0 mm.	75.0 mm.	42.5 mm.	30 mm.	
81.0 mm.	68.0 mm.	39.0 mm.	28.5 mm.	
79.0 mm.	65.5 mm.	38.0 mm.	30 mm.	(holotype)
71.0 mm.	61.0 mm.	36.5 mm.	25.5 mm.	
50.0 mm.	41.5 mm.	30.5 mm.	22.0 mm.	
<i>superba richardsoni</i>				
76.0 mm.	63.0 mm.	36.0 mm.	25.1 mm.	(holotype)
73.5 mm.	60.5 mm.	35.5 mm.	23.75 mm.	
72.0 mm.	58.0 mm.	36.0 mm.	24.5 mm.	
69.5 mm.	56.0 mm.	33.0 mm.	23.0 mm.	
60.0 mm.	49.0 mm.	28.0 mm.	22.0 mm.	
60.0 mm.	50.0 mm.	29.0 mm.	23.0 mm.	
59.5 mm.	49.0 mm.	29.5 mm.	22.5 mm.	
<i>superba mouatae</i>				
61.5 mm.	52.5 mm.	36.0 mm.	25.5 mm.	
57.0 mm.	47.5 mm.	30.0 mm.	23.0 mm.	
51.0 mm.	42.5 mm.	28.5 mm.	22.0 mm.	
50.0 mm.	42.5 mm.	27.0 mm.	22.1 mm.	(holotype)
<i>superba harveyi</i>				
64.00 mm.	54.0 mm.	31.0 mm.	25.0 mm.	(holotype)
62.75 mm.	51.0 mm.	29.5 mm.	25.0 mm.	
60.0 mm.	51.0 mm.	30.5 mm.	24.5 mm.	
47.5 mm.	41.0 mm.	28.0 mm.	22.0 mm.	

### C. THE GILLIESI SERIES.

#### **Paryphanta gilliesi (Smith, 1880).**

1880. *Paryphanta gilliesi* Smith, Ann. Mag. Nat. Hist. Ser. 5. Vol. 6, p. 159.

1930. *Paryphanta gilliesi* Powell, Rec. Auck. Inst. Mus. Vol. 1, Pt. 1, p. 44.

Smith's type is a collapsed shell in the British Museum from "Whakamarara Mountain, Collingwood." In my 1930 paper this was interpreted as Mt. Burnett, Collingwood, near the northern extremity of the Wakamarama Range. My material, from which I selected a neotype (Auckland Museum collection), was taken from between 1900 and 2000 feet. The Prouse cousins have now found the species to be common below the coal shaft at 600-700 feet, and they obtained several juveniles at 100-150 feet, but there are no records of these snails either from the coastal strip between Collingwood and Cape Farewell or the area flanking the road between Pakawau and West Haven Inlet. The nearest approach to *gilliesi* typical from elsewhere is from the Wakamarama Range, three miles south of Mt. Burnett and north of the Kaituna River (collected by Mrs. M. Mouat).

In *gilliesi* typical the base is bright red-brown, like rosewood, with a large, sharply defined, dark red-brown, almost black area surrounding the umbilicus. The top is umber shading to burnt-sienna and the dark brown spiral bands and lines are mostly rather distantly spaced.

#### **Paryphanta gilliesi subfusca Powell, 1930.**

1930. *Paryphanta gilliesi subfusca* Powell, Rec. Auck. Inst. Mus. Vol. 1, pt. 1, p. 47.

The type locality is Kaihoka, between the two lakes, in a small area of coastal forest containing "ponga" tree ferns and "nikau" palms, elevation 120 feet. The locality is isolated from the Wakamarama Range by the northern arm of West Haven Inlet.

In *subfusca* typical the base is olive-brown gradually deepening to dark greenish to reddish-brown around the umbilicus. The top is greenish-umber shading to sienna-brown and the dark-brown spirals are more numerous and of more even development with less of the ground colour showing than in *gilliesi* typical. A constant feature is the more rounded and compact peripheral outline, when viewed from above. In *gilliesi* typical the last  $\frac{1}{4}$  whorl accelerates.

Four other localities for *subfusca*, investigated by the Prouse cousins, reveals the presence of two colour forms, one with a basal colour of dull reddish-brown and the other deep red-brown as in *gilliesi* typical. The nearest match to *subfusca* is from Oyster Point,  $1\frac{1}{2}$  miles south of the type locality, on the north shore of West Haven Inlet, in small gullies containing coastal scrub, at 100-120 feet. These have the olive-brown base slightly diffused with reddish-brown, but are otherwise identical with those of the type locality.

*Form A.* This is a small colony found in dense manuka scrub at 150 feet on the south-west side of Green Hill Creek about two miles south-west of Wharariki, which is near Cape Farewell. The colony is characterized by rather stunted growth, and they have the base dull

reddish-brown, rood's-brown to burnt-sienna without the dark greenish factor. The top is burnt-sienna to dull reddish-brown and bears closely spaced, narrow, dark-brown spiral lines. In shape they lack acceleration as in typical *subfusca*.

*Form B.* This form occurs at Travers' Bush, 50 feet, separated from the Kaihoka locality by only twenty chains of clearing, but at a considerably lower elevation. An almost identical colony occurs at White Pine Creek, 20-25 feet, on the opposite shore of the northern arm of West Haven Inlet, almost due south of the Oyster Point locality. They occur under "toitoi," fern and rushes, in coastal scrub. These two colonies have the compact outline and closely spirally lined top of *subfusca*, but the zoned base of *gilliesi* typical. They are deep red-brown both above and below.

The whole of the West Haven area requires to be worked thoroughly before the distributional area for this form B can be satisfactorily determined; meanwhile it is left unnamed. Both the Travers' Bush and the White Pine Creek localities are probably remnants of a former widespread low level dispersal of this "red-*subfusca*" along the western drainage of the northern section of the Wakamarama Range.

From study of geological maps of the area (N.Z. Geol. Surv. Bull. No. 25) it would appear that *subfusca* typical is more or less restricted to the Miocene limestone coastal area and *gilliesi* typical to the older Tertiary Pakawau Series.

The Travers' Bush colony could be explained as an incursion into the limestone area from the older Tertiary area, for its location is near sea level at the head of the northern arm of the Inlet where no water barrier exists at present. On the other hand there may have been a water barrier between Travers' Bush and Kaihoka Lakes at a former period, for there is evidence of captured drainage, that is, if we assume a progressive extension of the northern arm of West Haven Inlet.

Another possibility remains to be investigated. How are the factors governing coloration affected when species are segregated into small colonies (see under *traversi* series)?

### **Paryphanta gilliesi aurea** n. subsp. Pl. 10, figs. 7 and 8.

This subspecies stands out from all others of the *gilliesi* series by its golden to olive basal ground colour and olive-brown dorsal surface. Reddish-brown, so characteristic of the other *gilliesi* forms, occurs in *aurea* normally, only as a diffused umbilical patch. In Ridgway's terminology the base is of old-gold ground colour overlaid with dense but inconspicuous narrow radial streaks of buffy-citrine. The diffused umbilical patch is mahogany-red to chestnut. The callus, which is strongly and densely granulated, approximates to dark indian-red. In contrast to the glossy ventral surface the dorsal area is rendered dull by dense microscopic wavy striations and is patterned with numerous strong spirals of dark-chestnut and subsidiary dark green lines. At the periphery there are two or three broad spiral bands of dark brown, the lower one frequently breaking down into several irregular dark

green lines. The base of the holotype exhibits faint narrow spiral brownish lines. Some paratypes have a conspicuous dark green basal line at about one-third the diameter in from the periphery. A few show a general diffusion of the reddish-brown umbilical area over the ventral surface, so that the base closely resembles that of *brunnea*, but such examples retain the characteristic olive-brown dorsal colour. The dorsal coloration is the most constant difference between *aurea* and *brunnea*. In *brunnea* both the dorsal and ventral surfaces are orange-brown, antique-brown to amber-brown.

Both *aurea* and *brunnea* occupy, respectively, two isolated small remnants of the original forest cover, one at low altitude, 20-30 feet, the other at 600 feet, and separated by only  $2\frac{1}{4}$  miles in direct line. Together these subspecies differ from all known forms of *gilliesi* in having the base almost devoid of definite colour zones and bands.

The species *compta*, from the opposite side of the Aorere Valley to the Wakamarama-West Haven *gilliesi* series, resembles *aurea* in ground colour and in the presence of occasional narrow green spirals as well as a diffused reddish-brown umbilical area. However, the umbilicus of *compta* is much narrower and the parietal callus is dark pinkish-grey with only a few scattered minute granulations.

Major diameter :	Minimum diameter :	height :
50.5 mm.	43.0 mm.	28 mm. (holotype)
48.5 mm.	42.0 mm.	30 mm.
48 mm.	42.0 mm.	26.5 mm.
47 mm.	42.0 mm.	30.75 mm.

*Locality*: Mangarakau, 600 feet, north of Paturau River, West Nelson, in a small area of coastal forest on the property of Mr. H. S. Prouse (see N.Z. Geol. Surv. Map, Onetaua, Pakawau and Paturau Survey Districts, Bull. No. 25). The locality for *brunnea* is on the north side of the Paturau, near the mouth at 20-30 feet.

*Holotype*: Auckland Museum.

Large series of both *aurea* and *brunnea* from the collections of Messrs. H. S. and R. A. Prouse, Mr. A. C. O'Connor, and examples presented to the Auckland Museum by the former, have been studied.

Both *aurea* and *brunnea* are restricted to small areas and their survival is uncertain.

### ***Paryphanta jamesoni* Powell, 1936.**

1936. *Paryphanta jamesoni* Powell, Rec. Auck. Inst. Mus. Vol. 2, No. 1, p. 35.

*Localities*: Blue Duck Creek, near hut at about 2,069 feet (type); Saxon Creek, Goulund Downs, West Nelson.

At least three recognisable forms of this species occur along the Goulund Downs track from the vicinity of Blue Duck Creek and Saxon Creek to the Collingwood boundary. Collingwood Boundary examples can be readily distinguished from those of Blue Duck Creek, the type locality, by their more reddish-brown colour, strong spiral banding of the top and peripheral area and obsolescence of the basal dark axial streaks. A third form from near Saxon Creek has dense narrow spirals



on the dorsal surface as in *fallax*, but the base is bright reddish-brown with strong subperipheral broad black spiral bands, reminiscent of *gilliesi*.

All the collections so far made have been from the two above-mentioned localities, which are about nine miles apart. Further collecting, especially from intermediate localities, is essential before these forms of *jamesoni* can be satisfactorily evaluated.

### E. THE TRAVERSI SERIES.

Owing to the fact that the once almost continuous lowland forest of the Horowhenua area has been destroyed to a very large extent for agricultural purposes, accurate reconstruction of the former distributional areas for *traversi*, its subspecies and forms, is now a difficult matter.

Except for a few occurrences on the foothills to the Tararua Range, at Kaihinu and Shannon Heights, these snails do not appear to have an extensive high country range. They were most strongly represented on the low country of the coastal plain, but today they survive only in a few of the small forest reserves scattered along the plain from Koputaroa, four miles north-east of Levin, to Te Horo, about 16 miles south-west of Levin.

From enquiries made by the Prouse cousins it is assumed that the large scale clearing of land for agricultural purposes in the Levin area was between 1890 and 1900. For the Shannon district earlier settlement is indicated.

The points to be considered are:—

- (1) Do the existing colonies suggest that there was natural segregation of forms in pre-European times?
- (2) Do the differences observed in colonies isolated at the present time suggest that such colonies are individually producing forms that are evolving along different lines due to this artificially induced isolation factor?
- (3) Does change in the nature of the forest cover, that is, the deterioration from virgin forest to scrub and fern, exert an influence in the production of new forms?
- (4) Are the diverse tendencies observed in certain small colonies a problem in genetics?

From study of long series, collected by the Prouse cousins, Mr. A. C. O'Connor and the writer, from a number of localities, isolated under present conditions, some more or less reasonable conclusions, together with some conjectures, are now given. As a preliminary to this discussion the following table sets out the main observable factors in the *traversi* series.

#### TABLE OF FACTORS IN THE FORMS OF TRAVERSI.

Dorsal Surface:—

- A. PLAIN TOP—Isabella colour (light yellowish brown), tinged with citrine—occasional weak spirals encroaching from peripheral area.

- B. REDDISH-BROWN TOP—Olive-lake to Dresden-brown, diffused and partially to completely spirally lined with Mars-brown, but no broad bands.
- C. HALF SPIRALLED TOP—Yellowish-citrine to buffy citrine with a few brown bands and lines mostly on outer half of whorls.
- D. COMPLETE SPIRALLED TOP—More or less completely spirally lined and banded with light to dark reddish-brown.
- E. COMPLETE SPIRALLED TOP + REDDISH-BROWN — Same as D, but diffused with reddish-brown.
- F. COMPLETE WAVY-SPIRALLED TOP—Olive-lake, with more or less uniform pattern of closely spaced wavy lines and bands of dark reddish-brown and occasional axial streaks of same colour.
- G. COMPLETE WAVY-SPIRALLED TOP + REDDISH-BROWN — Same as F, but diffused with dark reddish-brown.

Ventral Surface:—

- H. PALE YELLOWISH BASE—Yellowish-citrine with indistinct light-brown spiral lines and a central area of Mars-brown.
- I. GREENISH BASE—Greenish-olive with faint to moderate dark narrow spiral lines of olive and Roman-green and a central diffused patch of Mars-brown.
- J. NARROW SPIRALLED BASE—Numerous narrow brown spirals on old-gold ground with central area of diffused cinnamon-brown to Mars-brown.
- K. NARROW SPIRALLED DIFFUSED BROWN BASE—Very numerous narrow spirals generally diffused with reddish-brown.
- L. HEAVY SPIRALLED BASE—A fairly open pattern of dark-brown spiral bands and lines and a central area diffused with Mars-brown.
- M. DARK REDDISH-BROWN BASE—Almost uniformly dark warm brown with occasional narrow spirals of the pale ground colour showing through towards outer edge.
- N. DARK SEPIA BASE—Almost uniformly dark sepia with a few spirals of the pale ground colour towards outer edge and occasional light coloured axial streaks.

Callus:—

- O. PALE BLUE GREY—Pallid greyish violet-blue.
- P. DULL PURPLISH GREY.
- Q. PURPLISH LILAC streaked with Argyle-purple (colour fugitive).

Size:—

- R. FULL SIZE—attains 50-55 mm. (greatest diameter) and shows marked acceleration of last whorl.
- S. REDUCED SIZE—attains 40-45 mm. and shows very slight acceleration of last whorl.

These letter symbols may be employed to express approximately the combination of factors in any one shell, and groups of such symbols with percentages added may be used to define the composition of a mixed colony. The letter symbols are quoted in sequence, one from each of the four headings, i.e., dorsal surface, ventral surface, callus and size. Thus the four forms of *traversi* which I propose to give nomenclatural status can be expressed as follows:—

*traversi traversi* Powell, 1930. ALPR  
*traversi koputaroa* n. subsp. AHPR (see appendix).  
*traversi florida* n. subsp. EMPR  
*traversi tararuaensis* Powell, 1938. BIQR  
*traversi otakia* n. subsp. FNOR

The type locality for *traversi* is Waiapehu Reserve, but unfortunately over collecting coupled with the depredations of rats, hedgehogs and thrushes has all but exterminated the species from this small

reserve of original forest. Study of the original topotypic series shows the colony to have been composite, for it is situated in an area of overlap and intergradation, such as obtains in the Mt. Kiwi region between the two Marlborough Sounds, where *obscura* and *bicolor* meet with the resultant hybrid forms. Analysis of the Waiapehu colony shows the following forms:—

ALPR 50% (*traversi* typical)  
 AJPR 20%  
 EMPR 30% (*traversi florida*)

The "Plain-top" *traversi* typical (ALPR), occurs at eight now isolated localities mostly within a radius of about two miles of Levin town. It is found to be most stable from the Levin town area to the north-western end of Papaitonga or Buller's lake but composes only 50% of the Waiapehu type locality which is near the eastern limit of dispersal for the "plain-top" typical form.

The "dark reddish-brown based" *florida* form (EMPR) is pre-cinctive to the lower Ohau Valley and the foothills where the river emerges from the Ohau Gorge. Colonies from between the Ohau and Levin town show mixtures of these two forms. Past changes in the course of the Ohau River would explain this overlap. In an excellent paper by Mr. G. L. Adkin (Trans. N.Z. Inst. 43 pp. 496-520) it is presumed upon good evidence that the Ohau once flowed at a considerable distance north of its present course, passing through Lake Horowhenua, which is the dammed-up remnant of an earlier course of the river in Pleistocene times. It seems evident that the Ohau River has formed a fluctuating barrier to the free dispersal of the snails of the coastal plain even when the area was in virgin forest and that the development north of the river culminated in the "Plain-top" (ALPR) and that south of it in the dark-based (EMPR). Unfortunately the other two subspecies are completely and distantly isolated from the Levin colonies and thus we have no knowledge of intermediate forms which must have existed in the days of complete forest cover.

Three specimens taken by the Prouse cousins in September, 1945, are probably the last of a colony (doomed to destruction) from the coastal plain four miles north of Levin at Koputaroa. These are AHPR, and show closer relationship with the "pale-top" *traversi* typical than with *tataruaensis*, which seems to have been always a product of the high country.

The fact that snails from localities now completely isolated can be grouped into areas of distribution for a particular form is sufficient evidence that there was natural segregation of forms in pre-European times (point 1).

The table of factors given for the *traversi* series lists only the most striking forms, for there are many subtle variations difficult to define but obvious to the eye. With the dorsal pattern in particular it is noted that the Greenaway's locality produces a form which develops a few broad spiral bands, and similarly many of the artificially isolated local-

ities have colonies which collectively can be separated from other colonies by the presence of slight but recognisable differences. Therefore there is some grounds for surmising that present induced isolation resultant from the general clearing of the coastal plain between 1890 and 1900, is tending towards the production of further forms. Actually a new series of forms developing from and superimposed upon the wider areas of distribution of the former naturally restricted forms.

If the Levin snails survive in their present locations for say another fifty years, then a survey and analysis of the colonies may indicate if the above surmise is a reasonable one.

The Prouse cousins have established an experimental colony which may provide interesting data at some future time. One hundred snails from the Greenaway's locality (DMPR 70% + DKPR 30%), 925 feet, were liberated in a small forest reserve on the plain about two miles north of Levin, the locality being within the former range of *traversi* typical (ALPR). At the same time Mr. A. C. O'Connor liberated 40 examples of the Greenaway's snails at Khandallah. A duplicate series of 50 examples from Greenaway's have been prepared and are now deposited in the Auckland Museum as a standard to check any possible future variation in these newly established colonies. Both reserves were thoroughly searched prior to the liberation and proved to be without large snails. The reserve near Levin had been opened up by cattle at one stage but has since been fenced and is now approximately back to its original condition (point 2).

It seems fairly evident that in colonies which are persisting under adverse conditions there is a tendency towards smaller adult size without the normal acceleration of the last half whorl, and these factors are coupled with a general dark reddish-brown diffusion of the dorsal surface. Such snails occur at Shannon Heights and at Te Horo, and both these localities have been heavily trampled by cattle. These adverse conditions would appear to be reduced food supply, that is a scarcity of worms (they are carnivorous), and exposure to increased light and resultant dryness. Similar snails occur at Honore's, Jepson's and Stratton's, where the only cover is stunted second growth, fern and blackberry (point 3).

Colonies much reduced in numerical strength by being restricted to small areas often exhibit the most varied composition. Forest Reserve, which is contiguous with the general forest cover of the foothills has only one very constant form, but the nearby considerably reduced cover along the Ohau River at Florida Road shows three forms. Similarly Kaihinu, which until recently had extensive virgin cover, has a very stable form, but Waiapehu, a very small reserve, produced three forms.

I have already speculated upon the former courses of the Ohau River as a probable factor in the mixing of the *traversi* typical and *florida* subspecies, but there is a further factor to be considered, in that of genetics. In numerically small colonies there is not the same control of radical trends as in the case of a large colony where variants can be absorbed or swamped by mere numbers (point 4).

**Paryphanta traversi** Powell, 1930. Pl. 10, figs. 1 and 2.

1930. *Paryphanta traversi* Powell, Rec. Auck. Inst. Mus. Vol. 1, No. 1, p. 50.

The typical form of *traversi* is ALPR, that is, "plain-top," Isabella colour (light yellowish-brown), tinged with citrine, occasionally with weak spirals encroaching from the peripheral area. The base has a fairly open pattern of dark brown spiral bands and lines, and a central area of diffused Mars-brown, on a yellowish citrine to old gold ground. The parietal callus is dull purplish-grey. The holotype has a decidedly greenish tinge, but this has been acquired by long preservation in alcohol.

The typical species is a product of the Levin coastal plain, and occurred in its pure form mostly within a radius of two miles of Levin town. Its influence is apparent in composite colonies of the foothills behind Levin to as far west as the Makahika Stream, north to Koputaroa, and to a very small degree south of the Ohou. The type locality, Waiapehu Reserve, as already mentioned, is composite, with a strong admixture of EMPR, the *florida* form, due no doubt to meanderings of the lower course of the Ohau River.

Major diameter: Minimum diameter: Height: Depth of body-whorl:

53.5 mm. 45.0 mm. 27.0 mm. 18.5 mm. (R. A. Prouse's Bush.)

51.5 mm. 43.0 mm. 25.5 mm. 18.0 mm. (Waiapehu Reserve)

48.0 mm. 40.0 mm. 25.5 mm. 17.0 mm. (holotype).

*Localities:* Levin, Buller's Lake, Papaitonga, North West corner, ALPR 100%; Buller's Lake, North East corner, 90 feet (= Government Experimental Farm of my 1930 paper) ALPR 60% + CM-KPR 30% + AHPR 10%; Waiapehu Reserve, 225 feet, 2¼ miles east of railway (type) ALPR 50% + (EMPR 30%) + AJPR 20%; Koputaroa, 4 miles north east of Levin, 100 feet, in very small remnant of lowland forest, now almost completely destroyed, AHPR and probably other forms (insufficient material); Levin, R. A. Prouse's Bush, 120 feet, a small reserve of ten acres near railway station AKPR 80% + AJPR 20%; H. S. Prouse's Bush, Queen St., 175 feet, Levin, AJPR 100%; Park's Bush, Kawiu Road, 130 feet, Levin, CJPR 60% + CHPR 40%; Honore's, 1 mile east of Waiapehu Reserve on foothills, 325 feet, persisting out in the open under water fern (*Pteris scaberula*) and introduced St. John's Wort (*Hypericum perforatum*), forest milled and area partially burned in 1893 (EMPS 80%) + CKPR 10% + AKPR 10%; Muhunoa East, Florida Road, 200-250 feet, south side of Ohau River (EMPR 90%) + AKPR 5% + ALPR 5%; Makahika River, Adkin's Bush, 415 feet AJPR 50% + CJPR 50%; Greenaway's Bush, foothills west of Makahika River, 925 feet, DMPR 70% + DKPR 30%; Shannon Heights, foothills between Koputaroa and headwaters of Makahika River, 925 feet (EMPS 70%) + CHPR 20% + DKPR 10%.

*NOTE.*—All localities are given where the typical species or a near approach to it were found, and the letter symbols plus the percentages indicate its relative strength in composite colonies. Where symbols are enclosed in parentheses these elements belong to the next subspecies *traversi florida*. The map (Plate 8) gives a better indication of the distribution of the two subspecies *traversi traversi* and *traversi florida*. The dorsal factor C, "the half-spiralled top," occurs as a buffer between the respective areas occupied by the two above-mentioned subspecies. Thus the "half-spiralled top" by its distribution is clearly the result of hybridization between them.

See Appendix for description of *traversi koputaroa* n. subsp. AHPR.

***Paryphanta traversi florida* n. subsp, Pl. 10, figs. 3 and 4.**

This subspecies (EMPR) has a completely spirally lined top, diffused with reddish-brown, and a dark reddish-brown base with occasional narrow spirals of the light yellowish-brown ground colour, showing through, towards the outer edge. The parietal callus is dull purplish-grey. The spirals on the dorsal surface are very uneven in strength, some are clearly defined as dark lines and others are very fine and closely spaced in groups so that they appear as broad bands of paler colour. In the holotype there is a narrow spiral of ground colour above the periphery and four below it, the lowest situated on the base about one quarter of the radius in from the periphery. The result is four rather broad dark reddish-brown bands over the peripheral area.

Major diameter:	Minimum diameter:	Height:	Depth of body-whorl:
49.5 mm.	41.0 mm.	24.0 mm.	18.5 mm.
48.5 mm.	40.0 mm.	26.0 mm.	18.5 mm. (holotype)

*Localities:* Forest Reserve, Muhunua East, foothills towards Ohau Gorge, 400-500 feet EMPR 100% (type); Jepson's and Stratton's 400-500 feet;  $\frac{1}{2}$  to 1 mile south of Forest Reserve on cleared land, persisting in the open under fern and blackberry EMPS 80% + EKPS 20%; Florida Road, Muhunua East, 200-250 feet, south side of Ohau River EMPR 90% + (AKPR 5% + ALPR 5%); Kirkcaldie's Bush, a small reserve to the south of the Ohau River, EKPR 100%; Kimberley Road, 225 feet, north side of Ohau River, EMPR 50% + (DKPR 50%); Waiapehu Reserve, 225 feet (type locality for *traversi*) (ALPR 50%) + EMPR 30% + (AJPR 20%); Honore's, 1 mile east of Waiapehu Reserve on foothills, 325 feet under fern, etc., EMPS 80% + (CKPR 10% + AKPR 10%); Shannon Heights, foothills between Koputaroa and headwaters of Makahika River, 925 feet, EMPS 70% + (CHPR 20% + DKPR 10%). *NOTE:* In the composite colonies the use of parentheses indicates the percentage which relates to the previous subspecies *traversi* typical.

*Holotype:* Auckland Museum.

***Paryphanta traversi tararuaensis* Powell, 1938.**

1938 *Paraphanta traversi tararuaensis* Powell. Rec. Auck. Inst. Mus. Vol. 2, No. 3, p. 138.

This is the only high country occurrence for the *traversi* series so far known. It seems to be fairly restricted in the vicinity of Kaihinu at 1500-2000 feet, about four miles east of Tokomaru on a western outlier of the Tararua Range. The actual type locality was a small forest remnant about a mile west of Kaihinu Peak, but through general thinning of the area by cattle the chance of survival of the subspecies at the actual type locality is slender.

This high country form is BIQR, that is, dorsal surface olive-lake to Dresden-brown, diffused and partially to completely spirally lined, but not banded with Mars-brown. The ventral surface is greenish-olive with faint to moderate dark, narrow, spiral lines of olive and Roman-green and a central diffused patch of Mars-brown. The parietal callus is purplish-lilac streaked with Argyle-purple, but this colouring is very fugitive and quickly fades to a dull grey.

Major diameter:	Minimum diameter:	Height:	Depth of body-whorl:
52.5 mm.	43.0 mm.	25.0 mm.	19.0 mm.
50.0 mm.	41.0 mm.	24.0 mm.	17.5 mm.
43.0 mm.	35.0 mm.	22.0 mm.	16.0 mm. (holotype)

**Paryphanta traversi otakia** n. subsp. Pl. 10, figs. 5 and 6.

This, the Otaki subspecies, FNOR, is the most southern occurrence of the *traversi* series. It is separated from the *florida* subspecies by nine miles of coastal plain from which the forest has been removed entirely. Except for the Te Horo occurrence no *Paryphanta* has been found on the foothills until the Ohau area to the north is reached.

Ground colour olive-lake. Dorsal surface more or less completely covered with a spiral pattern of closely-spaced, narrow, slightly wavy, dark reddish-brown lines, crossed by irregular narrow dark-brown axial streaks which follow the growth lines. Ventral surface with an all-over zone of dark warm-sepia which is broken up below the periphery by three narrow interrupted lines of the olive-lake ground colour. This gives the effect of three broad sub-peripheral bands.

Parietal callus pale blue-grey; pallid greyish violet-blue (Ridgway). The variation is not great—some have the top spirals rather sparse, showing more of the olive-lake ground; others are so densely lined that they appear dark reddish-brown. The ventral surface is very constant—some show occasional axial streaks of the pale ground colour and others a varying number of sub-peripheral spirals.

About 20% of the examples collected at Te Horo are of stunted growth, and have the dorsal surface strongly diffused with dark reddish-brown (i.e., GNOS compared with FNOR for the typical form). I have already referred to this tendency towards smaller adult size, lack of acceleration of the last whorl, and a general dark reddish-brown diffusion of the dorsal surface. These factors are almost invariably associated with colonies which are persisting under the adverse conditions of increasing light and dryness, occasioned by the opening up of the bush with the trampling of the undergrowth by cattle.

Major diameter :	Minimum diameter :	Height :	Depth of body-whorl :
50.0 mm.	40.5 mm.	25.0 mm.	18.0 mm.
49.0 mm.	40.25 mm.	25.0 mm.	18.0 mm.
48.0 mm.	39.5 mm.	26.0 mm.	18.0 mm. (holotype)

*Localities:* Rahui Road, 200 feet, Otaki (type FNOR 100%) near Te Horo 300-400 feet. (FNOR 80% + GNOS 20%). These localities are about three miles apart and are situated to the north and to the south of the Otaki River, respectively.

*Holotype:* Auckland Museum.

Unfortunately the chance of survival of this subspecies appears slender unless further colonies are located. The Rahui Road type locality yielded a small series only, but a few were left, including all juvenile and half-grown examples. The Te Horo locality is about ten acres in extent, but much of it has been thinned, and trampled by cattle, and in consequence snails are very scarce.

This subspecies was discovered by Messrs. R. A. and H. S. Prouse. It bears a striking resemblance to some of the hybrid forms of *obscura* x *bicolor* from the Mount Kiwi area of the Marlborough Sounds, the only marked difference being that *obscura* and *bicolor* have the deep body-whorl of the *hochstetteri* series, but the *traversi* subspecies has the shallow body-whorl as in the West Nelson *gilliesi* group.

If the *gilliesi* group arose from the *lignaria* series as a small shallow-whorled mutation, then there is no reason why a similar but separate origin cannot be claimed for the *traversi* series from a prototype of the *obscura-bicolour* series.

To derive the *traversi* series from the Marlborough Sounds area rather than from the *gilliesi* series which lie much further westward is more natural, and is in accord with the main axial dispersal of *Wainuia* both north and south of Cook Strait.†

The position is complicated by *marchanti*, which shows alliance with the eastern Marlborough *bicolor* but occurs along the high country of the Ruahine Range, there being no record, so far, of snails of this deep-whorled group from the Tararua Range.

Further speculation is not warranted until the high country of the Tararua Range is more thoroughly searched.

†Since the above was written a most interesting occurrence has been brought to my notice by Miss L. B. Moore and Mr. W. Harris of the Plant Research Bureau, Wellington. Collapsed shells of a *Paryphanta* closely resembling a small *obscura* (46.5 mm.) were found not uncommonly at the Wallaceville Swamp, an area of peat bog in the Mungaroa Valley just east of the main Hutt Valley, Wellington.

They were on the surface of the peat, not embedded, under cover of a derelict *Phormium* plantation.

My revised contention that *traversi* probably originated from Marlborough Sounds *obscura-bicolor* stock has been strengthened by this unexpected new record. There is a possibility that this snail still lives in the vicinity and pending an exhaustive search I withhold description of the imperfect material so far available.

### Genus WAINUIA Powell, 1930.

Type (o.d.): *HELIX URNULA* Pfeiffer.

Mr. L. C. King (1939) has presented an interesting hypothesis in "that the central segment of New Zealand has been subjected to intense shearing stress associated with the later stages of the compression which formed the New Zealand mountain ranges. This has resulted in the rupture of once-continuous geological and topographical features and the development of a definite offsetting between the North and South Islands."

By a series of structural maps King shows firstly the conjoined islands in such a position that the main axes of both islands were united, as also were the Kaikoura Mountains of the South with the Haurangi Mountains of the North, these combined systems then lying eastward and parallel to the main axis. The South Island is then assumed to have moved westward and northward in relation to the North Island, disrupting the continuity of the above-mentioned parallel systems. As the southern portion of the united islands moved to the west, the Marlborough Sounds triangular block tended to stay with the North Island, so that a split developed between it and the mountainous country of North-west Nelson (i.e., Tasman Bay). "When further movement of the South Island relative to the North Island occurred, the Marlborough Sounds block was also carried to the west, opening up a new rift which now forms Cook Strait."



In the light of the above hypothesis, new locality records for *Wainuia urnula* are of interest. The typical species is now known from the Tararua and Rimutaka Systems of the North Island, Kapiti Island, Ruahine Range and (a new subspecies, described herein) D'Urville Island. The D'Urville Island occurrence is now the only authentic record of an *urnula* type in the South Island, and its position to the westward of Kapiti Island and the Tararua-Rimutaka main axial distribution is significant.

The Kaikoura *Wainuia* occurrences are now regarded as a new species more akin to the North Canterbury *edwardi* than to *urnula*. If there is a *Wainuia* on the Haurangi Mountains of the North Island it should show affinity with *edwardi* rather than with *urnula*.

The only other *Wainuia* is *clarki* Powell, 1936, from the recent volcanic island of Motutaiko in Lake Taupo, a problematic occurrence. Intensive collecting on the intervening high country in both islands will be necessary to reveal the complete order of dispersal of this interesting genus.

### **Wainuia urnula** (Pfeiffer, 1855). Text figs. B8-10; C3.

*Localities*: Ridge at back of Lowry Bay, 1,000 feet; Butterfly Creek near Day's Bay, 400 feet; Korokoro, near Petone, 800 feet; Wainuiomata, 1200 feet (type); Rimutaka Mountains, 1,700 feet; Khandallah, 1,000 feet; Porirua, 50 feet (empty shells) (A. C. O'Connor); Paraparaumu, 2,000 feet (H. Hamilton); Rahui Road, Otaki, 200 feet; Waikawa River, Manakau, 500 feet (R. A. and H. S. Prouse); Mt. Holdsworth (H. W. Simmonds); Tokomaru-Mangahao Divide, 3,000 feet; Tararua Range; Kapiti Island, 1,700 feet; Copper Creek, foothills of Ruahine Range, ten miles north of Woodville; Mokai-Patea Trig, Ruahine Range, 3,600 feet (A. C. O'Connor).

### **Wainuia urnula nasuta** n. subsp. Pl. 9, fig. 9. Text figs. B11-14.

Examples collected by Mr. A. C. O'Connor at 2,000 feet on D'Urville Island, Cook Strait, are readily distinguished from typical *urnula* by a constant difference in coiling, which results in relatively lower height and a more produced termination to the body-whorl. Viewed from above, the coiling in *urnula* is normally helicoid except for the last quarter of the body-whorl which swings outward at an increasing rate. In *nasuta* acceleration commences earlier, at the last third of the body-whorl, and swings outward with even greater rapidity. Again viewed from above, the outer lip has a narrowly pointed termination, low down, in *urnula*, but this is bluntly rounded and higher up in *nasuta* (point X in text figures). Also the minimum diameter is proportionately less in *nasuta*. These essential differences are more clearly shown by the diagrams and the dimensions given below. Several senile examples have the last sixth of the body-whorl suddenly incurved, causing a humped outline to the periphery. Coloration, radial corrugations and width of the umbilicus are as in the typical species.

Dimensions of *urnula* and *urnula nasuta*.

	Major diameter :	Minimum diameter	Height :	
<i>urnula</i>	25.5 mm.	19.5 mm.	18.5 mm.	(Manakau)
	24.5 mm.	17.5 mm.	16.5 mm.	(Manakau)
	24.25 mm.	17.75 mm.	17.0 mm.	(Paraparaumu)
	24.0 mm.	18.0 mm.	17.0 mm.	(Wainuiomata)
	22.0 mm.	16.0 mm.	15.0 mm.	(Wainuiomata)
	16.0 mm.	13.0 mm.	9.0 mm.	(type)

<i>nasuta</i>	27.5 mm.	20.0 mm.	16.8 mm.	
	26.5 mm.	18.0 mm.	16.5 mm.	(type)
	26.2 mm.	19.5 mm.	16.35 mm.	
	25.2 mm.	18.3 mm.	16.0 mm.	

*Locality*: Mount Maude, 2,000 feet, D'Urville Island Cook Strait (A. C. O'Connor, 12:10:1942).

*Holotype*: Auckland Museum.

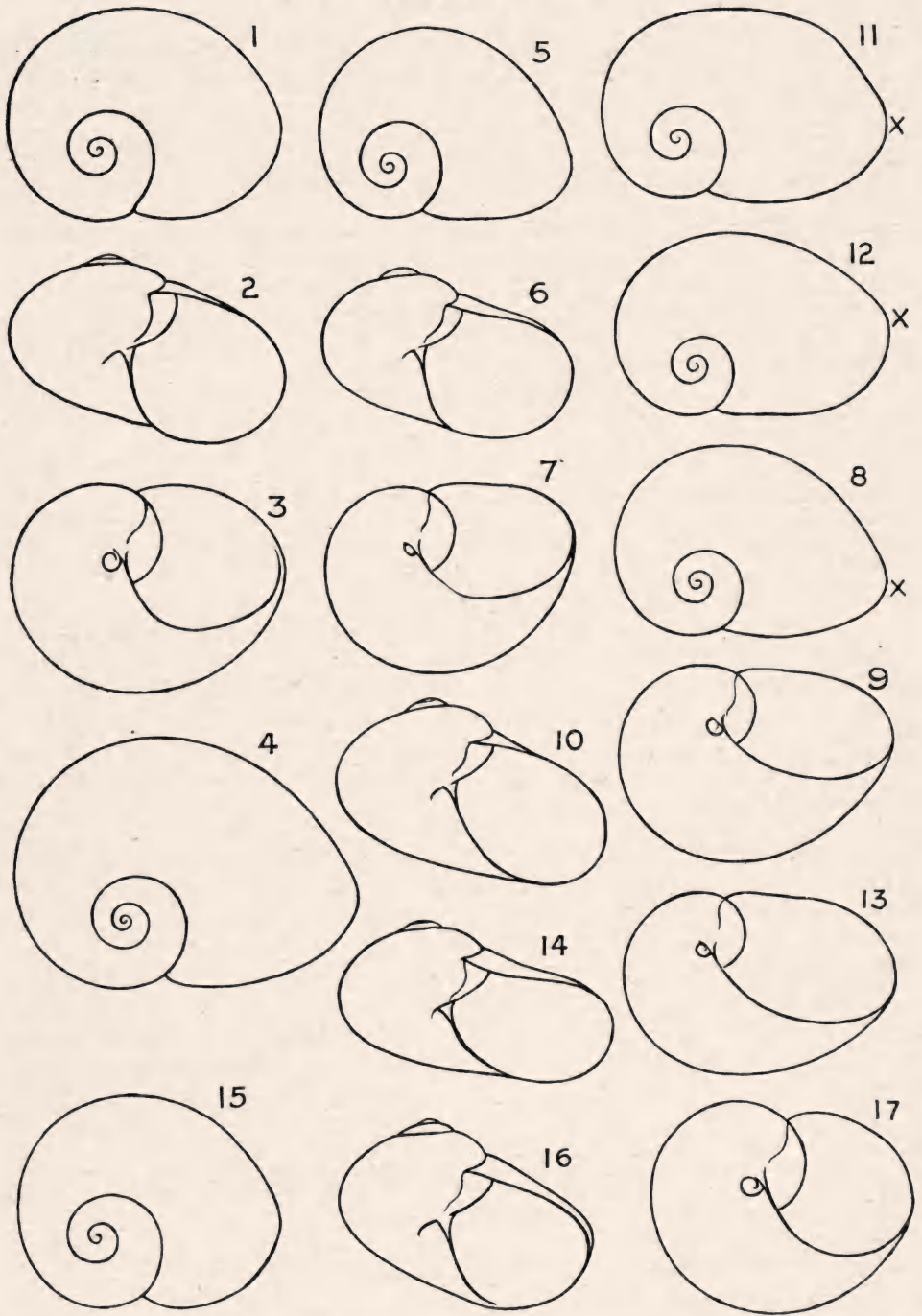
The writer is indebted to Dr. R. A. Falla for the loan of series of *Wainuia* from five North Canterbury and Marlborough localities. These can be readily separated into three forms, two of them of specific value and the third probably a subspecific form of one of them (*edwardi*). Their distribution is as follows.

- (1) *edwardi* (Suter, 1899), Hossack Downs (type); Little Lottery Creek, 1,000 feet (H. E. Fyfe), N.E. of Hamner, North Canterbury. This is the largest species of the genus (37 mm. x 27.5 mm. x 22.5 mm., Little Lottery Creek), it has oblique radiate plications, the umbilicus is comparatively large and when adult, but only then, the last half-whorl shows considerable acceleration.
- (2) *edwardi* n. subsp.? Mount Oxford, North Canterbury. These are probably a constantly smaller form of *edwardi* (26 mm. x 20.5 mm. x 18.5 mm.). It has a comparatively large umbilicus, is more strongly obliquely plicate than *edwardi* typical and shows considerable acceleration of the last half-whorl. Typical *edwardi* at this size does not show acceleration. In *fallai* the umbilicus is small and there are no radial plications.
- (3) *fallai* n. sp. Seaward Kaikouras, 450-1,500 feet. This is the species which was the basis of my 1930 (p. 52) South Island records of *urnula*. It is about the size of *urnula* (24.5 x 19.0 mm. x 17 mm.), but does not obtain the extreme acceleration of the last whorl of that species. By its dentition it is related to *edwardi* rather than to *urnula* and it differs from both in having the plications obsolete. The umbilicus differs from that of *edwardi* in being very small as in *urnula*.

### **Wainuia fallai** n. sp. Pl. 9, figs. 7 and 8; Text figs. B5-7; C5.

Shell small, about the size of the North Island *urnula*, but of more circular outline with very slight acceleration of the last whorl, almost smooth, and with a very small umbilicus. Whorls  $3\frac{1}{2}$ ; protoconch and early whorls buff to light brown; body-whorl dark sepia, almost black. Sculpture subobsolete, weak closely-spaced radials on the protoconch, faint malleations on the spire whorls but the transverse folds almost completely obsolete. The whole surface bears very indistinct microscopic irregular spiral striations. Umbilicus very small and half hidden by the reflected inner lip.

*Dentition*: Very similar to that of *edwardi*. Formula  $24 + 1 + 24$ , compared with  $26 + 1 + 26$  for both *edwardi* and *clarki*,  $14 + 1 + 14$  for *urnula* and  $27 + 1 + 27$  for the Mt. Oxford subspecies. (Text fig. C.)

**Text Fig. B.**

- 1-3. *Wainuia edwardi* (Suter, 1899). Hossack Downs (immature).  
 4. *Wainuia edwardi* (Suter, 1899). Hossack Downs (Paratype).  
 5-7. *Wainuia fallai* Powell, n. sp. Monkeyface, Kaikoura.  
 8-10. *Wainuia urnula* (Pfeiffer, 1855). Manakau, Wellington.  
 11-14. *Wainuia urnula nasuta* Powell, n. subsp. D'Urville Island.  
 15-17. *Wainuia clarki* Powell, 1936. Motutaiko Island, Lake Taupo.

(All figures to uniform scale of 14)

At present there is insufficient material to warrant separating the Mt. Oxford shell, which is presumed to be subspecifically distinct, from *edwardi*.

The species is named in recognition of the fact that Dr. Falla had previously claimed the Kaikoura snails to be distinct.

*Localities:* Mount Fyfe, Kaikoura; Kaikoura, 400 feet; Monkeyface, Kaikoura (type, R. A. Falla); Lower end of Monkeyface Ridge (A. G. Macfarlane); Mount Ross, Seaward Kaikouras, 450-1,500 feet (R. A. Falla).

*Holotype:* Canterbury Museum, Christchurch.

Major diameter:	Minimum diameter:	Height:
24.5 mm.	19.0 mm.	17 mm. (holotype)
25.0 mm.	19.0 mm.	17 mm. (paratype)

### **Wainuia clarki** Powell, 1936. Text figs. B15-17; C4.

1936 *Wainuia clarki* Powell, Rec. Auck. Inst. Mus., Vol. 2, No. 1, p. 36.

*Locality:* Motutaiko Island, Lake Taupo.

I am indebted to Mr. A. G. Stevenson for the animal of this species. The numerical formula of the radula is  $26 + 1 + 26$ , the same as for the South Island *edwardi*, but in the North Island *urnula* it is only  $14 + 1 + 14$ . The other South Island species, *fallai*, has numerous teeth also,  $24 + 1 + 24$ . Both on shell features and in dentition *clarki* shows closer relationship with the South Island species than it does with *urnula*.

Since *urnula* has the lower main axial distribution for the North Island (Tararua and Ruahine Ranges) it is problematic why a *Wainuia* not allied to *urnula* is found to the west of the main axis. The Kaimanawa Mountains between Taupo and the main axis, the Huiarau and Raukumara Mountains of the Middle and Upper sections of the main axis as well as the East Wellington systems, the Haurangi and Maungaraki Mountains and Puketoi Hills, all require investigation before useful comment can be made upon the apparently anomalous distribution of *clarki*.

### Genus **RHYTIDA** Albers, 1860.

Type: *HELIX GREENWOODI* Gray.

### **Rhytida meesoni** Suter, 1891. Text figs. D10-11.

1891 *Rhytida meesoni* Suter. Trans. N.Z. Inst. Vol. 23, p. 84.

1913 *Rhytida meesoni* Suter. Man. N.Z. Moll. p. 776, Pl. 50, f. 13.

Major diameter 11.5 mm.; minimum diameter 9 mm.; height 6 mm. (holotype).

*Localities:* Wairoa Gorge Nelson (type); Kenepuru (McMahon); Manaroa, Pelorous Sound (A. C. O'Connor).

Suter (1913 l.c.) records this species from Collingwood, West Nelson and Hossack Downs, North Canterbury. I have not seen Hossack Downs material, but the Collingwood record belongs to the new subspecies described below.

**Rhytida meesoni perampla** n. subsp. Text figs. D7-9.

The dimensions given by Suter for *meesoni* are about the maximum for the typical species, which seems to be restricted to Eastern Nelson and the Marlborough Sounds. All occurrences from the Pikipiruna Range and North Western Nelson Province are much larger than *meesoni* typical and are more strongly radiately malleated.

Whorls  $3\frac{3}{4}$ , the last considerably accelerated towards its termination. Dorsal surface sculptured with rather strong dense malleations, fold-like, anastomosing and retractively arcuate, but confused over the last half whorl. The spiral striations are microscopic and subobsolete. Umbilicus one-tenth the major diameter of the base.

In *meesoni* the whorls are slightly less than  $3\frac{3}{4}$ , the last half whorl accelerates in similar fashion, but the malleations are weak, the spiral striations much stronger, and the umbilicus is one-sixth the major diameter of the base.

Half grown *perampla* of equal size to adult *meesoni* afford the best basis of comparison for the differences in sculpture.

Major diameter:	Minimum diameter:	Height:
15.0 mm.	11.0 mm.	8.5 mm. (holotype)
15.0 mm.	11.2 mm.	8.5 mm. (Takaka Saddle)
14.25 mm.	11.0 mm.	8.0 mm. (Anatoki Forks)

*Localities:* Takaka Saddle, Pikipiruna Range, 2,700 feet (A.W.B.P. 23:12:1927); Anatoki Forks, West Nelson, 2,400 feet (type) (A. C. O'Connor); Quartz Range, east of Bainham, 500-600 feet (A. C. O'Connor); Paturau River, West Nelson (H. S. Prouse, -:3:1941).

*Holotype:* Auckland Museum.

Since the above was written Mr. A. C. O'Connor has provided an animal of *perampla* from Takaka. The formula is  $14 + 1 + 14$ , increasing to the fourteenth, which is largest, and medially ridged as in the *patula* series. Suter gives the formula for *meesoni* as  $12 + 0 + 12$ , increasing to the tenth, which is largest. Re-examination of the *meesoni* radula is now required to determine if the largest tooth is medially ridged also.

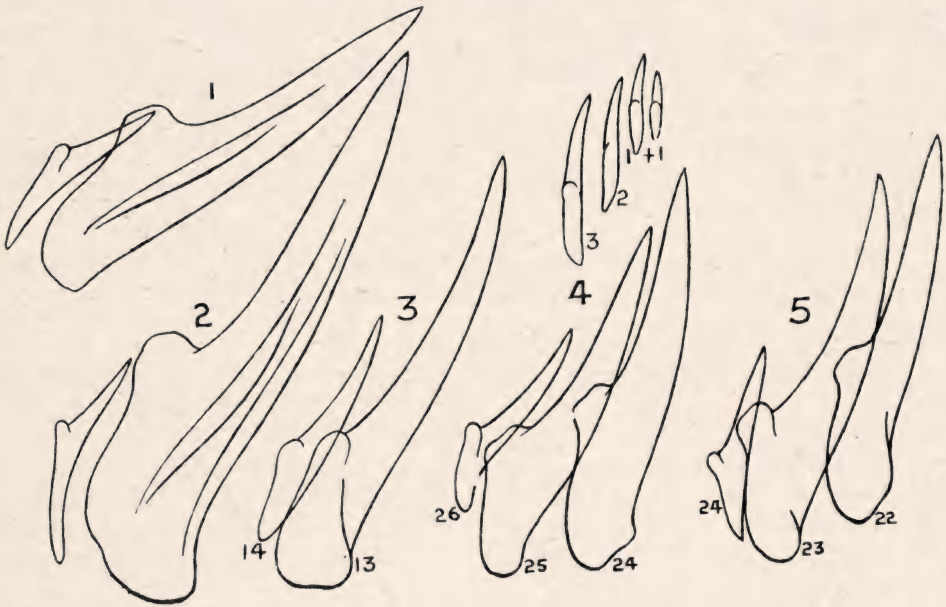
**Rhytida patula** Hutton, 1833. Text figs. D4-6; C2.

1883 *Rhytida patula* Hutton, Trans. N.Z. Inst. Vol. 15, p. 139.

Major diameter:	Minimum diameter:	Height:
23.0 mm.	16.3 mm.	12.0 mm. (Lectotype)
19.5 mm.	14.5 mm.	12.0 mm. (co-type)
17.2 mm.	13.0 mm.	10.5 mm. (co-type)
20.0 mm.	15.0 mm.	12.0 mm. (St. Helens)
20.0 mm.	15.0 mm.	12.0 mm. (Oyster Point)

*Localities:* Greymouth (type); Capleston near Reefton; Lake Kanieri (A. C. O'Connor); St. Helens, Mokihinui (A.W.B.P. 27/12/1927); Oyster Point, West Haven Inlet (H. S. Prouse).

The largest of Hutton's series of six co-types is here selected as Lectotype.



Text Fig. C.

## DENTITION.

1. *Rhytida citrina* Hutton, 1883. Buller River, Nelson.
2. *Rhytida patula* Hutton, 1883. Oyster Point, West Haven Inlet.
3. *Wainuia urnula* (Pfeiffer, 1855), 14 + 1 + 14. Wainuiomata, Wellington.
4. *Wainuia clarki* (Powell, 1936), 26 + 1 + 26. Motutaiko Is., Lake Taupo.
5. *Wainuia fallai* Powell, n. sp., 24 + 1 + 24. Kaikoura.

**Rhytida citrina** Hutton, 1883. Text figs. D1-3; C1.1883 *Rhytida citrina* Hutton, Trans. N.Z. Inst. Vol. 15, p. 139.

Major diameter :	Minimum diameter :	Height :	
22.0 mm.	17.0 mm.	12.5 mm.	(Maruia Springs)
19.0 mm.	15.0 mm.	12.0 mm.	(Rewanui)
18.5 mm.	15.0 mm.	11.5 mm.	(Buller River)
16.25 mm.	12.5 mm.	10.0 mm.	(Lake Kanieri)
9.0 mm.	7.0 mm.	6.0 mm.	(Lake Kanieri)
7.75 mm.	6.0 mm.	6.0 mm.	(largest co-type)*

*Localities:* Greymouth (type); Seven Mile Creek, Rewanui, North of Greymouth (A. C. O'Connor); Otira, 2 miles below railway station (A.W.B.P. 30:12:1927); Lake Kanieri (A. C. O'Connor); Maruia Springs, Lewis Pass (R. A. Cumber).

\*Suter gave these dimensions for the largest of the three type specimens which he noted is evidently not adult. I have not seen the types which Dr. Falla has been unable to locate in the Canterbury collections. Two of Hutton's Greymouth specimens in the Canterbury Museum are 5.5 mm. and 8.5 mm., respectively, major diameter.

Both *patula* and *citrina* were described from Greymouth material, but the latter unfortunately was a juvenile. From Greymouth to the Buller River two forms occur, a reddish-brown one with a greatly accelerated last whorl which is definitely *patula*, and a yellowish-olive one with closely coiled whorls which is almost certainly the adult of *citrina*. In North West Nelson, only the reddish-brown *patula* occurs and the absence there of a *citrina* form would indicate that there are two species, for the two are not entirely coincident in range.

Since Hutton's type of *citrina* was a juvenile, the radula differences he noted (Hutton, Trans. N.Z. Inst. 16, p. 167) probably do not obtain in the adult. A specimen labelled *citrina* by Hutton from Buller River is in the Canterbury Museum. It is an adult, or nearly so, of 18.5 mm. diameter, and has closely coiled whorls and the yellowish-olive coloration of *citrina*. This specimen had the animal dried hard within the shell, but I was able to soften it and mount the radula. The dentition is not as Hutton described it for his juvenile type, 17+0+17, with the fifteenth tooth larger than the sixteenth, but much nearer to that of *patula*. Hutton gave the dental formula for his *patula* as 18+0+18, outermost tooth very small, seventeenth the largest and bearing a central ridge. Hutton's Buller specimen has the formula of 16+1+16 and the outermost tooth is very small followed by the largest, which is ridged as in *patula*. The Oyster Point, West Haven Inlet specimens are typical *patula*, both on shell characters and in dentition, that is, 18+0+18 with the seventeenth tooth strongly ridged. The fact that the nascent portion of the radula in the Buller specimen shows the teeth to be much more aculeate and without the ridge on the largest tooth is almost conclusive evidence that my interpretation of the adult *citrina* is correct. It may be noted that my *R. otagoensis* (Powell 1930, p. 32) belongs to the *patula-citrina* group, for it has the largest tooth similarly ridged, but the formula is 14 + 0 + 14,

**Rhytida oconnori** n. sp. Pl. 9, fig. 10. Text figs. D12-14.

The shell resembles that of *patula*, but is more tightly coiled, with a larger, more circular aperture, a proportionately greater minimum diameter and peripheral ridges additional to the normal radiate malleations. Whorls  $3\frac{3}{4}$ , including a flat protoconch of  $1\frac{1}{2}$ , finely radiately ribbed whorls. Dorsal surface of post-nuclear whorls malleated by a laterally compressed network of anastomosing radial ridges. Ventral surface with numerous, simple, fine, radial growth lines. Periphery narrowly rounded, bearing about six irregular, rather strong, upwardly inclined spiral ridges. Aperture large, subcircular, much advanced above. Umbilicus deep, about one fourteenth the major diameter.

The species is a combination of the *patula* form and the *greenwoodi* peripheral ridges. Its actual relationship would appear to be nearer to the former.

Major diameter :	Minimum diameter :	Height :	
26.3 mm.	21.0 mm.	16.0 mm.	(Paratype, A. C. O'Connor)
20.75 mm.	16.5 mm.	13.5 mm.	(Holotype)
26.0 mm.	21.0 mm.	17.0 mm.	(Paratype)
20.5 mm.	15.0 mm.	12.0 mm.	( <i>patula</i> )
20.0 mm.	15.0 mm.	12.0 mm.	( <i>patula</i> )

*Locality*: Punipaua Creek, subfossil in cave with moa bones, two miles down the coast from Paturau River and one-third of a mile in from the sea coast.

*Holotype*: Auckland Museum.

Discovered by Mr. A. C. O'Connor and here named in recognition of both his able field work and his excellent paper on the eggs of the *Paryphantidae* (1945).

**Rhytida duplicata** Suter 1904. Text figs. D15-16.

1904 *Rhytida duplicata* Suter, Proc. Malac. Soc. Lond. Vol. 6, p. 155.

*Localities*: Cape Maria van Diemen (type); Cape Maria van Diemen, mainland, in consolidated dunes (A.W.B.P., Feb., 1932); Tom Bowling Bay, in consolidated dunes (A.W.B.P. and C. A. Fleming, Feb., 1932).

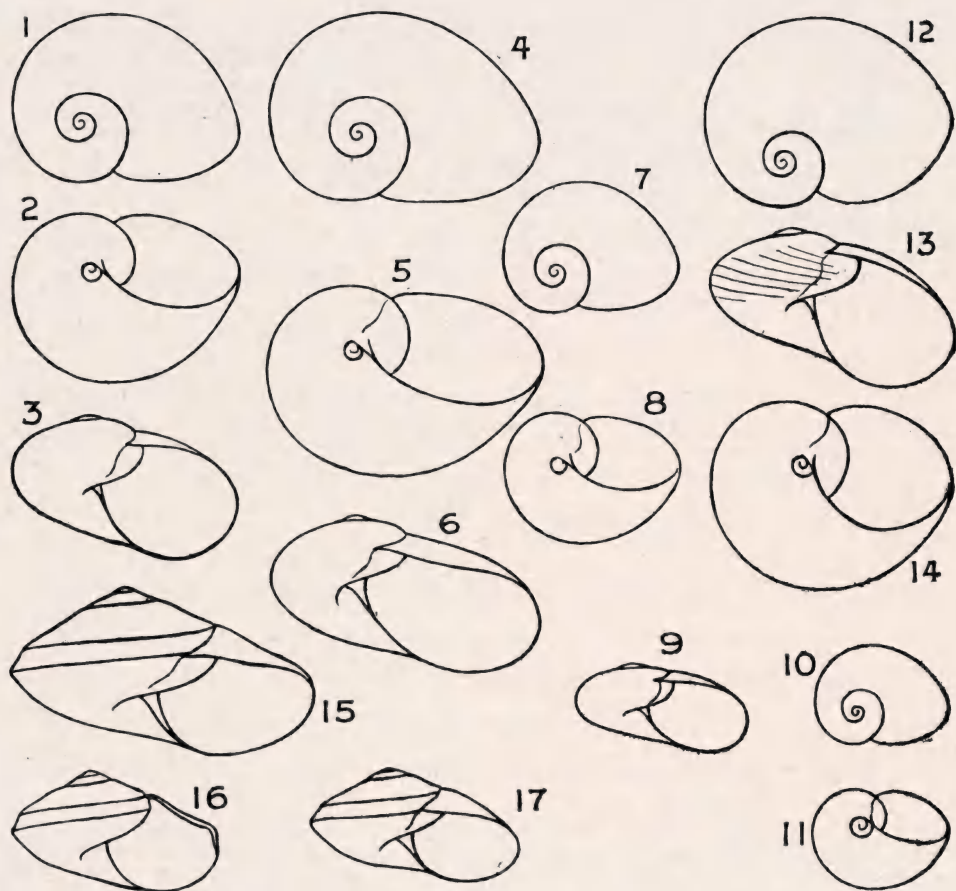
In 1932 (Rec. Auck. Inst. Mus. Vol 1, No. 3, p. 155) the writer recorded living examples of this species from the "Far Northern Block," but it is now proposed to separate subspecifically the living form from the subfossil type.

**Rhytida duplicata vivens** n. subsp. Text fig. D17.

1932 *Rhytida duplicata*: Powell, Rec. Auck. Inst. Mus. Vol. 1, No. 3, p. 155 (in part) Recent localities and figure of radula, Text fig. 4.

The only difference between the subfossil type and the Recent subspecies is the constant smaller size of the latter. In *duplicata* the adult shell has  $4\frac{1}{2}$  whorls and has a maximum diameter of 26 mm., but the largest *vivens* found has  $4\frac{1}{4}$  whorls and a maximum diameter of only 18.5 mm. Examples of *duplicata* of the size of the largest *vivens* are definitely juvenile, for they lack acceleration of the last whorl and the aperture is thin, angulated, and its upper margin does not descend



**Text Fig. D.**

- 1-3. *Rhytida citrina* Hutton, 1883. Rewanui, Greymouth.  
 4-6. *Rhytida patula* Hutton, 1883. Greymouth (Lectotype).  
 7-9. *Rhytida meesoni perampla* Powell, n. subsp. Anatoki Forks, West Nelson.  
 10-11. *Rhytida meesoni* Suter, 1891. Manaroa, Pelorus Sound.  
 12-14. *Rhytida oconnori* Powell, n. sp. Subfossil. Punipaua Creek, West Nelson.  
 15. *Rhytida duplicata* Suter, 1904. Subfossil. Cape Maria van Diemen.  
 16. *Rhytida duplicata* Suter, 1904. Subfossil (immature). Cape Maria van Diemen.  
 17. *Rhytida duplicata vivens* Powell, n. subsp. Unuwahao, North Auckland. (adult, holotype).

(All figures to uniform scale of  $1\frac{1}{2}$ )

to the level of the lower carina, a feature common to the adults of both species and subspecies. Three field trips have failed in the finding of *vivens* of larger size than 18.5 mm.

Major diameter:	Minimum diameter:	Height:	
26.0 mm.	21.0 mm.	15.0 mm.	( <i>duplicata</i> , Cape Maria)
25.5 mm.	21.0 mm.	15.0 mm.	( <i>duplicata</i> , Cape Maria)
24.0 mm.	20.0 mm.	14.0 mm.	( <i>duplicata</i> , Cape Maria)
24.0 mm.	20.0 mm.	12.0 mm.	( <i>duplicata</i> , holotype)
18.5 mm.	15.5 mm.	11.0 mm.	( <i>vivens</i> )
18.25 mm.	14.5 mm.	10.5 mm.	( <i>vivens</i> , holotype)

*Note.*—All dimensions are of adult shells.

A single egg was found in February, 1932. It is white, calcareous, 3 mm. x 2.5 mm., and without a cuticle.

*Dentition:* 15 + 1 + 15 (Powell, 1932, l.c.).

*Localities:* Unuwahao, 900-950 feet, near track between Spirits Bay and Tom Bowling Bay under decaying leaves in coastal forest. (A.W.B.P., Feb., 1932); Kahuronaki (Kahoroa on survey maps), between Te Paki and Kapo-Wairua Road (A.W.B.P., Feb., 1944); near North Cape (R. A. Falla, Feb., 1932).

*Holotype:* Auckland Museum.

## FAMILY PARYPHANTIDAE.

(Synopsis of the New Zealand members of the family)

### Genus 1. *Rhytida* Albers, 1860

(Type: *HELIX GREENWOODI* Gray)

- (1) *R. greenwoodi* (Gray, 1850) North of Auckland to northern part of South Island.
- (2) *R. stephenensis* Powell, 1930. Stephen Island, Cook Strait.
- (3) *R. spelaea* Powell, 1933, Subfossil, Hawkes Bay.
- (4) *R. dunniae* (Gray, 1840), Kaitaia to Thames.
- (5) *R. tarangaensis* Powell, 1930. Taranga, Hen and Chickens Islands.
- (6) *R. pycrofti* Powell, 1932. Poor Knights Islands.
- (7) *R. duplicata* Suter, 1904. Subfossil, Cape Maria van Diemen.
- (8) *R. duplicata vivens* Powell, n. subsp. Unuwahao, extreme north, N.Z.
- (9) *R. patula* Hutton, 1883. Greymouth to West Nelson.
- (10) *R. citrina* Hutton, 1883. Greymouth to Reefton.
- (11) *R. oconnori* Powell, n. subsp. Subfossil, Punipaua Creek, West Nelson.
- (12) *R. meesoni* Suter, 1891. East Nelson and Marlborough.
- (13) *R. meesoni perampla* Powell, n. subsp. West Nelson.
- (14) *R. otagoensis* Powell, 1930. Southland.
- (15) *R. australis* Hutton, 1883. Stewart Island.

### Genus 2. *Paryphanta* Albers, 1850.

(Type: *HELIX BUSBYI* Gray)

#### Subgenus *Paryphanta* Albers, 1850.

- (1) *P. busbyi* (Gray, 1840), Kaitaia to Kaipara; Poor Knights Islands; Hen and Chickens.
- (2) *P. watti* Powell, n. sp. Extreme north of N.Z.

Subgenus **Powelliphanta** O'Connor, 1945.(Type: *HELIX HOCHSTETTERI*)

## (a) ROSSIANA series.

- (3) *P. spedeni* Powell, 1932. Opposite East Dome, Southland.  
 (4) *P. spedeni lateumbilicata* Powell, n. subsp. Billow Mountains, near Lake Monowai.  
 (5) *P. rossiana* Powell, 1930. Mount Greenland, Ross, Westland.  
 (6) *P. fletcheri* Powell, 1938. Mt. Tuhua, Westland.  
 (7) *P. gagei* Powell, 1938. Rewanui, Greymouth; Kirwan's Hill, Reefton.

## (b) LIGNARIA series.

- (8) *P. unicolorata* Powell, 1930. Seddonville, on the flat.  
 (9) *P. unicolorata rotella* Powell, 1938. Western slopes of Mt. Glasgow.  
 (10) *P. unicolorata johnstoni* Powell, n. subsp. Western side of Chasm Creek, Seddonville.  
 (11) *P. lignaria* Hutton, 1888. Lyell Range (type) and Mokihinui River to Karamea?  
 (12) *P. lignaria oconnori* Powell, 1938. Leslie River; Western slopes of Mt. Arthur.  
 (13) *P. annectens* Powell, 1936. Karamea to Heaphy River.  
 (14) *P. superba* Powell, 1930. High country, both east and west of Aorere Valley, West Nelson.  
 (15) *P. superba prouseorum* Powell, n. subsp. Between Kahurangi Point and Rocks Point, West Nelson.  
 (16) *P. superba harveyi* Powell, n. subsp. Heaphy section of Goulard Downs track, West Nelson.  
 (17) *P. superba mouatae* Powell, 1936. Near Saxon Creek, Goulard Downs.  
 (18) *P. superba richardsoni* Powell, n. subsp. Perry's Pass, Goulard Downs.

## (c) GILLIESI series.

- (19) *P. gilliesi* (Smith, 1880). Northern end of Wakamarama Range, West Nelson.  
 (20) *P. gilliesi subfusca* Powell, 1930. Kaihoka, North side West Haven Inlet.  
 (21) *P. gilliesi montana* Powell, 1936. Southern section of Wakamarama Range, West Nelson.  
 (22) *P. gilliesi brunnea* Powell, 1938. North side of Paturau River near mouth, West Nelson.  
 (23) *P. gilliesi aurea* Powell, n. subsp. Mangarakau, North of Paturau River, West Nelson.  
 (24) *P. gilliesi kahurangica* Powell, 1936. Kahurangi Point, West Nelson.  
 (25) *P. jamesoni* Powell, 1936. Goulard Downs Track, West Nelson.  
 (26) *P. compta* Powell, 1930. The Castles, Eastern side Aorere Valley, West Nelson.  
 (27) *P. fallax* Powell, 1930. Ngarino and Onekaka Ridges, West Nelson.

## (d) HOCHSTETTERI series.

- (28) *P. hochstetteri* (Pfeiffer, 1862) Pikipikiruna Range, Nelson.  
 (29) *P. hochstetteri anatokiensis* Powell, 1928. Western end of Tasman Range, West Nelson.  
 (30) *P. hochstetteri obscura* Beutler, 1901. Western Marlborough Sounds, D'Urville Island and Stephen Island.  
 (31) *P. hochstetteri consobrina* Powell, 1936. Mt. Duppa and area between Pelorus and Queen Charlotte Sounds.  
 (32) *P. hochstetteri bicolor* Powell, 1930. Eastern Marlborough Sounds.  
 (33) *P. marchanti* Powell, 1932. Ruahine Range.

## (e) TRAVERSI series.

- (34) *P. traversi* Powell, 1930. Levin, north of Wellington.  
 (35) *P. traversi koputaroa* n. subsp. Koputaroa to Manawatu (see Appendix).  
 (36) *P. traversi tararuaensis* Powell, 1938. Kaihinu, east of Tokomaru.  
 (37) *P. traversi florida* Powell, n. subsp. Foothills, Muhunua East, south of Levin.  
 (38) *P. traversi otakia* Powell, n. subsp. Otaki, north of Wellington.

**Genus 3. Wainuia Powell, 1930.**(Type: *HELIX URNULA* Pfeiffer)

- (1) *W. urnula* (Pfeiffer, 1855) Wellington; Tararua Range; Kapiti Island; Ruahine Range.
- (2) *W. urnula nasuta* Powell, n. subsp. D'Urville Island.
- (3) *W. edwardi* Suter, 1899) Hossack Downs, North Canterbury.
- (4) *W. fallai* Powell, n. sp. Seaward Kaikoura Range.
- (5) *W. clarki* Powell, 1936. Motutaiko Island, Lake Taupo.

**Genus 4. Schizoglossa Hedley, 1902.**(Type: *DAUDEBARDIA NOVOSEELANDICA* Pfeiffer)

- (1) *S. novoseelandica* (Pfeiffer, 1862). North Island.
- (2) *S. gigantea* Powell, 1930. Subfossil, cave near Tahora, Gisborne.
- (3) *S. major* Powell, 1938. Subfossil, Pukemiro, Waikato.

**Genus 5. Delos Hutton, 1904.**(Type: *ZONITES CORESIA* Gray)

- (1) *D. coresia* (Gray, 1850). North Island.
- (2) *D. jeffreysiana* (Pfeiffer, 1853). North Island.

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## APPENDIX.

***Paryphanta traversi koputaroa* n. subsp.**

Additional information concerning the distribution of the *Paryphanta traversi* series resulted from a recent trip when a fortnight was spent with Messrs. R. A. and H. S. Prouse in the search for further colonies of snails.

An important discovery was a small colony of a low country form still persisting under adverse conditions in a small area of second growth native bush fringing a raupo swamp. The colony is situated on the Horowhenua Plain at approximately one and a half miles N.N.E. of Koputaroa Railway Station.

The Plain between Levin and the Manawatu River is now almost completely denuded of forest, the few small areas remaining being mostly low level kahikatea remnants subject to flooding and therefore without snails.

The Koputaroa snail represents a further new subspecies (AHPR of my table, see pp. 115-116), and its former distribution was probably over most of the northern part of the Horowhenua Plain from Koputaroa and Shannon to the Manawatu River.

Two specimens from the Charles Cooper collection, Auckland Museum, labelled "Manawatu," and a small series taken by a Mr. Gower in 1910 from near Koputaroa (site since cleared) are both AHPR. The base of the AHPR form is pale yellowish-citrine with very indistinct light-brown spiral lines and a central area of Mars-brown. This form is almost 100% pure at the new Koputaroa locality (about 2% are A-BLPR) and the basal-factor occurs in small percentages in several composite colonies to the north and north-east of Levin, i.e., Shannon Heights, CHPR 20%; Park's Bush, Kawi Road, Levin, CHPR 40%; and Lake Papaitonga, N.E. corner, AHPR 10% (% probably much less if the series was larger).

There has been no apparent topographic barrier between the typical Levin *traversi*, ALPR and the Koputaroa-Manawatu AHPR, but they are noticeably different at both the north and south extremes of the distributional area, although considerable integradation is apparent at intermediate locations. Extensive swamps probably exercised a partial segregating influence.

The high country *traversi tararuaensis*, BIQR is clearly a development from the AHPR Koputaroa-Manawatu form rather than from *traversi* typical ALPR.

Major diameter, 52.5 mm. Minimum diameter, 43 mm. Height, 27 mm. (holotype)

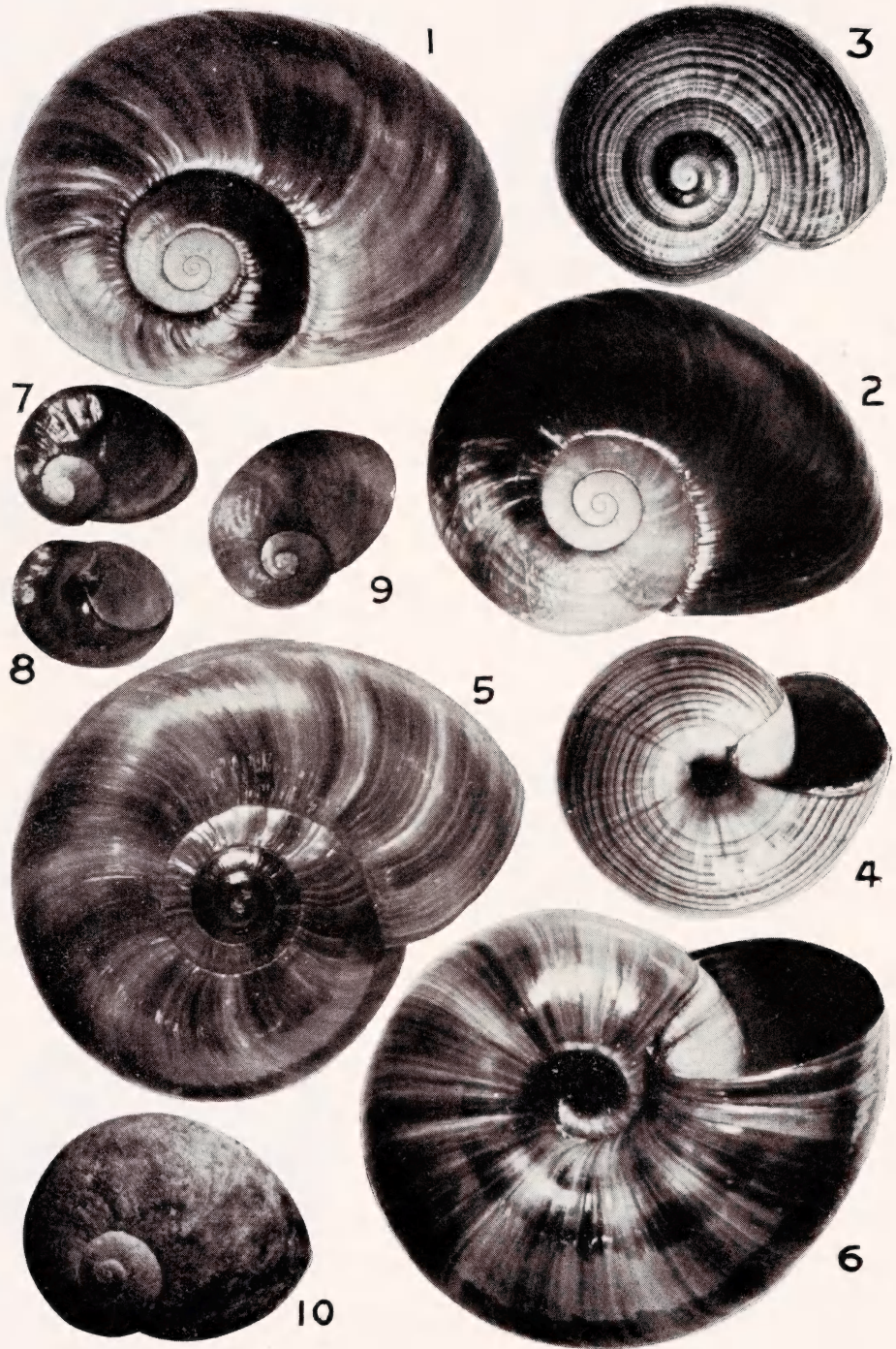
*Holotype*: Auckland Museum.

A figure will be provided in the next part of this series.



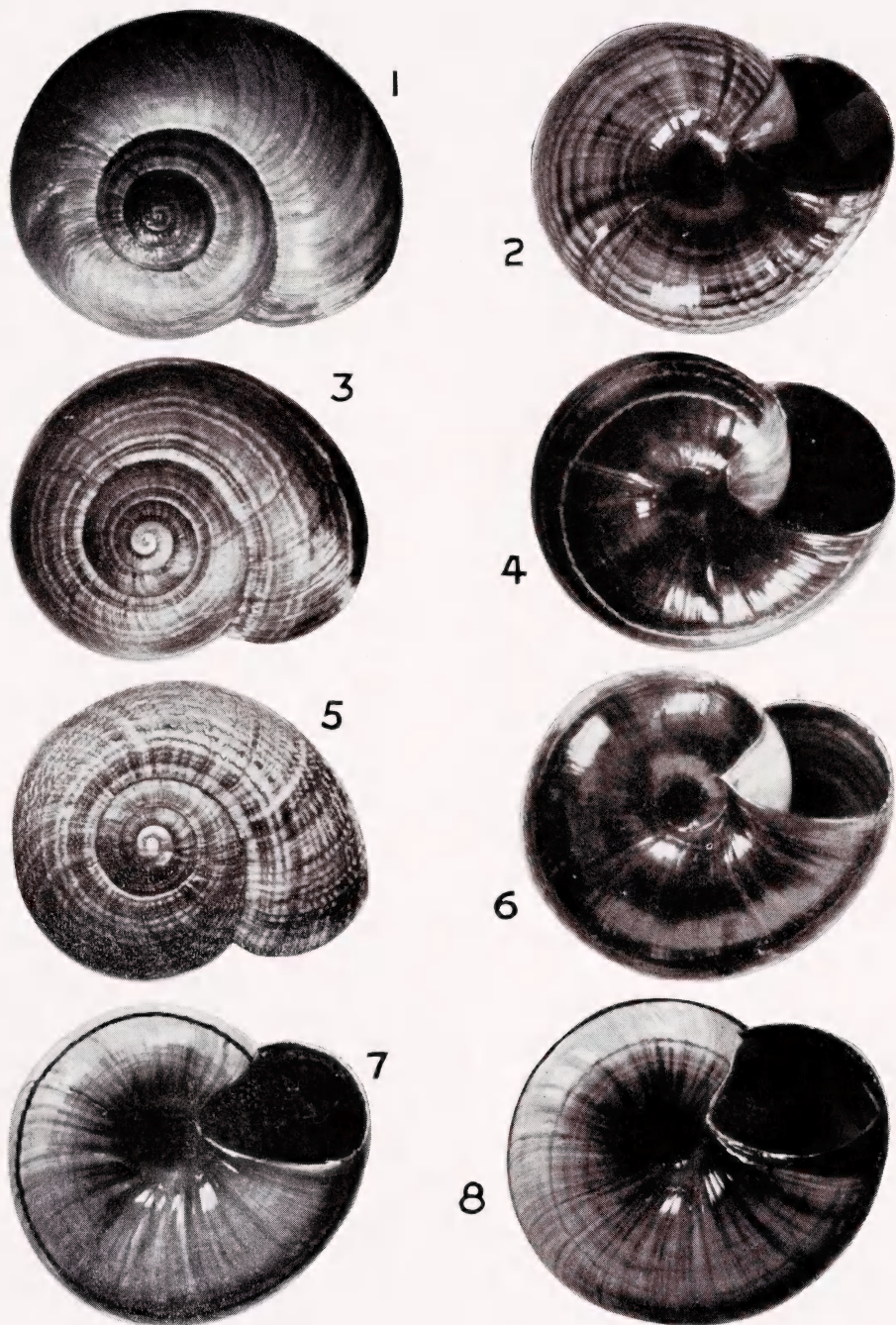
DISTRIBUTION OF TRAVERSI SUBSPECIES ON HOROWHENUA COASTAL PLAIN.

Showing type localities and areas of distribution for *traversi*, *florida* and *otakia*. The line shading represents native forest. The lettered symbols, i.e., ALPR, are explained in the text, and the numerals following these symbols are percentages. (See Appendix for description of *traversi koputaroa* AHPR.)



1. *Paryphanta busbyi* (Gray, 1840) 64.5 x 36 mm. Avoca, N. Auckland.  
 2. *P. watti* n. sp. 62 x 31 mm. Holotype. 3. & 4. *Paryphanta* (*Powelliphanta*)  
*unicolorata johnstoni* n. subsp. 45.5 x 37 mm. Holotype. 5. & 6. *P. (P.) superba*  
*harveyi* n. subsp. 64 x 54 mm. Holotype. 7. & 8. *Wainuia fallai* n. sp. 24.5 x  
 19 mm. Holotype (Fig. 7). 9. *W. urnula nasuta* n. subsp. 27.5 x 20 mm.  
 Paratype. 10. *Rhytida oconnori* n. sp. 20.75 x 16.5 mm. Holotype.





1. *Paryphanta (Powelliphanta) traversi* Powell, 1930. 52 x 43.5 mm. Lake Papaitonga, Levin. 2. *P. (P.) traversi* Powell, 1930. 48 x 40 mm. Holotype. 3. *P. (P.) traversi florida* n. subsp. 48.5 x 40 mm. Holotype. 4. *P. (P.) traversi florida* n. subsp. Paratype. 5. & 6. *P. (P.) traversi otakia* n. subsp. 48 x 39.5 mm. Holotype. 7. *P. (P.) gilliesi aurea* n. subsp. Paratype. 8. *P. (P.) gilliesi aurea* n. subsp. 50.5 x 43 mm. Holotype.